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THE SOLAR HEATING AND COOLING CENTRAL DATA
PROCESSING SYSTEM (IBM Federal Systems Div.)
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SECTION A

CENTRAL DATA PROCESSING SYSTEM SOFTWARE PERFORMANCE SPECIFICATION

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1. INTRODUCTION

The Central Data Processing System (CDPS) is the Central Integration Facility which transforms the raw data collected at remote sites into performance evaluation information for assessing the performance of solar heating and cooling systems.

This CDPS Software Performance Specification (CSPS) provides the medium for baselining the overall software system requirements. After baselining, the software requirements will be placed under change configuration control and can be changed only through formal change procedures established by the Marshall Space Flight Center (MSFC). Through this procedure, the document will remain current with the requirements/capabilities of the CDPS software throughout the contractual period.

The objective of this document is to establish the requirements which must be satisfied by the CDPS software. All descriptions of and references to the CDPS hardware configuration are only to facilitate explanation of the software requirements and not to control the configuration of the hardware. The CDPS hardware is controlled by IBM and is used for support of multiple contract programs. To support this varying utilization environment, IBM must maintain the flexibility to modify the configuration as required. Because of this flexibility requirement, the CDPS hardware configuration may vary during the performance of the SINS contract, but the capability to satisfy all SINS processing requirements contained within the CDPS Hardware Performance Specification will be maintained. This document will not be updated to reflect changes in the detailed CDPS hardware configuration which do not affect CDPS software requirements.

The programming standards to be used in development, documentation and maintenance of the software are discussed in Appendix A. In addition, the CDPS operations approach in support of daily data collection and processing is discussed in Appendix B.

1.1 CDPS ROLE IN SOLAR HEATING AND COOLING PROGRAM

The CDPS, located at IBM's FSD facility in Huntsville, Alabama, provides the resources required to assess the performance of solar heating and cooling systems installed at remote sites. These remote sites consist of residential, commercial, government, and educational types of buildings, and the solar heating and cooling systems can be hot-water, space heating, cooling, and combinations thereof. The instrumentation data associated with these systems will vary according to the application and must be collected, processed, and presented in a form which supports continuity of performance evaluation across all applications. In addition, data must be maintained for historical purposes and for detailed analysis.

In supporting the overall program objectives, the CDPS satisfies the following functional requirements:

Data Collection - The CDPS daily collects instrumentation data from all remote sites via standard voice-grade 1200 Baud telephone lines. In addition, non-instrumentation data available from MSFC, ERDA, HUD, etc., which is needed in performing overall system evaluation, is collected via manual means.

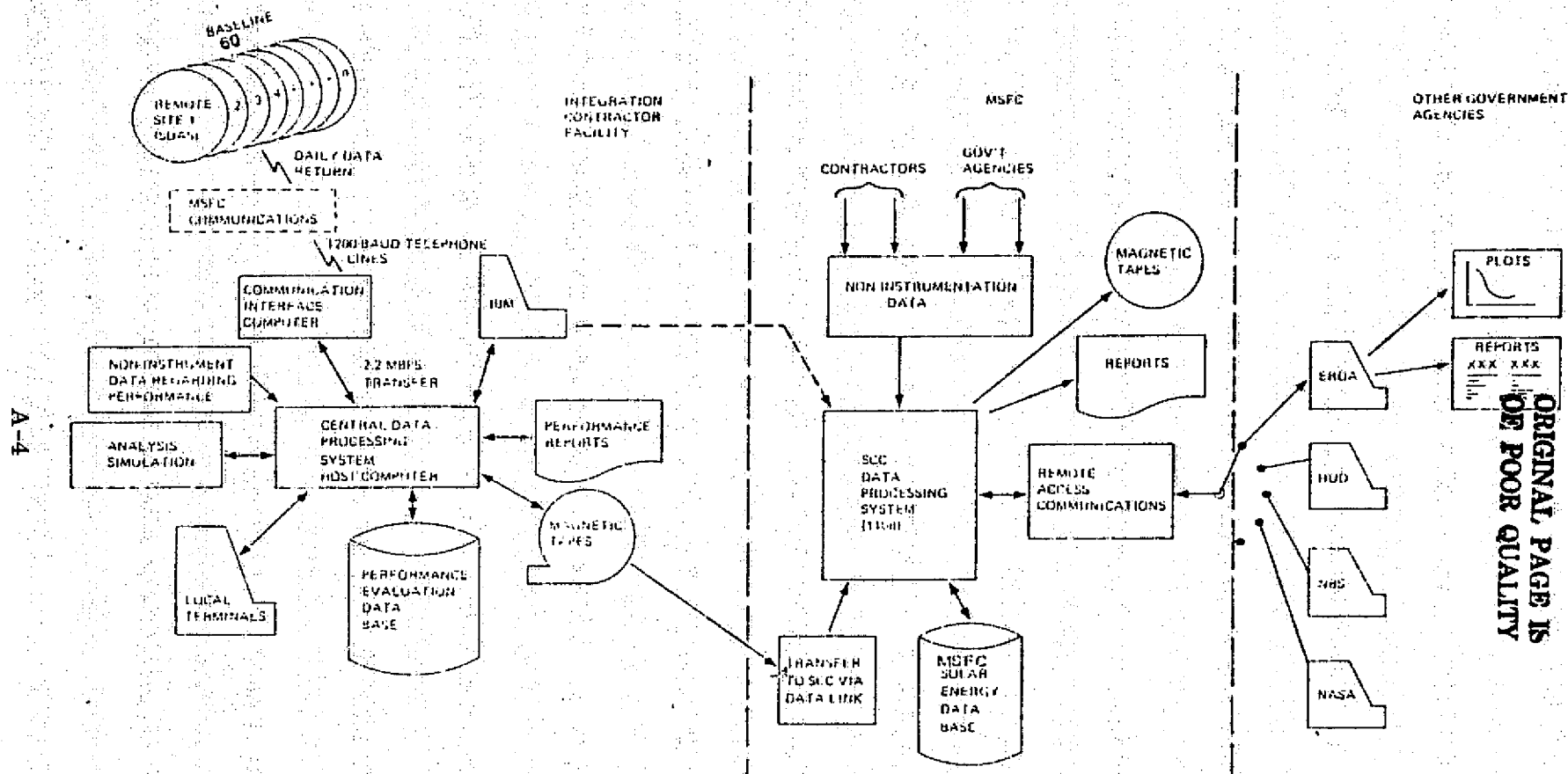
Data Processing - The CDPS accepts raw data, as collected by the data collection function, and performs the data processing functions required to transform the raw data into processed information for use in system evaluation/analysis activities. The CDPS also provides the resources to maintain a performance evaluation data base, containing both raw data and processed information, for use in support of performance analysts.

Data Archiving - To provide capability for detailed analyses of system performance and to maintain data for historical purposes, the CDPS provides the capabilities to archive data collected and processed during the program. Both raw data and processed data is retained on magnetic tape, and formal reports are archived in a library.

Data Distribution - In addition to collection, processing, and archiving of data, the CDPS provides the essential function of distributing the data to the appropriate organizations. Distribution is in the form of printed reports, data plots, and magnetic tapes.

Systems Analysis Simulation - An essential capability in assessing the performance of solar heating and cooling systems is the ability to predict performance for correlation with operational performance. The CDPS provides the resources needed in support of this simulation activity and provides capabilities for automated correlation of predicted and actual performance.

As shown in Figure 1, the CDPS consists of three major elements - communication interface computer, central data processing computer, and performance evaluation data base. These three elements provide the capabilities required to satisfy the functions mentioned above.



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1.2 CDPS FUNCTIONAL REQUIREMENTS

In performing its role within the solar heating and cooling demonstration program, the CDPS, through its hardware/software, shall satisfy overall system requirements. A summary of these system requirements is given in the following paragraphs:

Growth Potential - Because of the distinct possibility of growth in the data collection and processing requirements as additional sites are added to the program, the CDPS shall be designed to allow growth in capability with a minimum of cost.

Data Collection - To support timely processing/presentation of data in support of the performance evaluation activities, daily collection of data shall be provided from all remote sites.

Timely Processing of Data - The processing data flow within the CDPS shall minimize the delay between receipt of data at the CDPS and availability of processed information. An operations goal will be to provide processed information and reports at the start of first shift each day.

Operations Personnel - The design goal of the system shall be to minimize operations personnel utilization during data collection and processing. Software shall provide built-in error detection/recovery techniques to allow maximum of automatic control.

SDAS/CDPS Communication - Because of the availability of software/proven concepts on other programs which use telephone lines for automatic data collection, maximum benefit of this prior experience shall be utilized to reduce program risk.

System Recovery - The overall data collection concept shall provide the flexibility to ensure that site data is not lost through failure of the communication interface or host computer. Backup shall be provided to restore entire contents of performance evaluation data base in the event of computer malfunction.

Data Archiving - Within any demonstration program, availability of historical data must be provided in order to support the performance evaluation activities. The CDPS shall support this archiving of data and provide the means of identifying the location for timely retrieval.

User Support - Because of the requirements generated through a diverse user community, the CDPS shall provide a flexible user support capability which can be easily structured to satisfy needs.

Flexibility - Because variations in instrumentation at remote sites, the CDPS shall support the processing of variable input formats.

1.3 CDPS HARDWARE DESCRIPTION

As shown in Figure 1, the CDPS hardware consists of . communication interface computer configuration and a host computer configuration. The following paragraphs briefly describe the components of each of these configurations.

1.3.1 Communication Interface Configuration

The communications interface configuration provides the capability to collect data from remote sites via 1200 baud voice-grade telephone lines. WATS lines will be used for this communication and will be supplied by the Government. In addition, the communications facility at MSFC will provide the necessary communications hardware to support the data collection functions. Automatic dial-up and command interface with the remote sites will be provided by the communications interface computer.

The communication interface configuration operates in a standalone mode of operation and consists of:

- (1) An IBM System/7 computer with input/output peripherals to support operator interface, report generation, and data storage.
- (2) Communication interface hardware for communications with remote sites via telephone lines.
- (3) Hardware to support collection of data via manual means.
- (4) Communication hardware for transfer of data to the host computer configuration (IBM S/370-145).

The overall hardware elements are shown in Figure 2 and are discussed in the following paragraphs.

1.3.1.1 System/7 Computer

As can be seen in Figure 2, the System/7 computer configuration consists of the following hardware:

- (1) Central Processing Unit (CPU)
- (2) Memory
- (3) Teletype Keyboard/Printer (5028)
- (4) Disk Storage (5022)
- (5) Printer (7431)

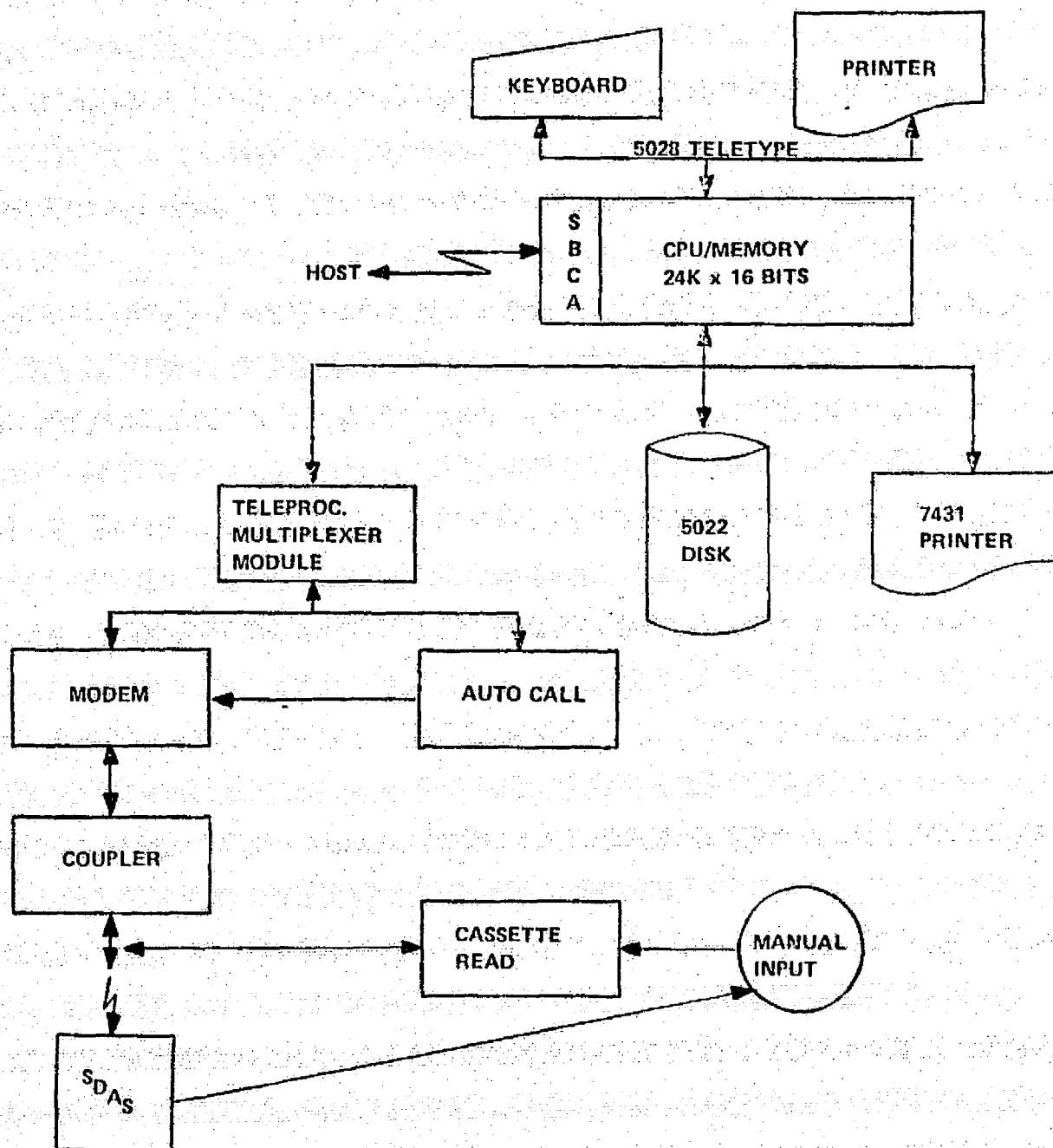


Figure 2. Communication Interface Configuration

These hardware, with capabilities relative to COPS objectives, are discussed below:

Central Processing Unit (CPU) - The Central Processing Unit supports an interrupt-driven, multi-program environment through a priority interrupt system. A total of 6 interrupt levels with 16 sublevels are provided. Seven index registers, an accumulator register, and an instruction address register are supported for each interrupt level. The CPU also provides 2 interval timers for timekeeping and program control. Addressing capability for up to 64K - 16 bit words is supported.

Memory - 24K Words of 16 Bits Each - Main storage provides the communication processor with fast access, adequate storage to provide the control, interface and application programs necessary for control of the communications interface. The main storage can be expanded to 64K words through field modification.

Teletype Keyboard Printer - The Teletype Keyboard Printer provides the operator interface required during program load, initiation of data collection and SNA troubleshooting. In addition, the printer provides hard copy reports in support of communication logging, memory dumps for software debug, and maintains status of software operation.

Disk Storage - The baseline configuration contains one disk unit which provides storage for a maximum of 2.45 million 16-bit words. The unit supports mountable disk files to allow storage of data in excess of 2.45 million words.

Printer - The printer provides the capability for generation of communication and error reports during data collection. The printer has the capability to print 115 characters per second.

1.3.1.2 Communication Interface Hardware

The communication interface hardware provides the interface capabilities which allow the system computer, under software control, to automatically collect data from remote sites via telephone lines. This hardware, shown in Figure 2, consists of:

- (1) Teleprocessing Multiplexer Module (TMM)
- (2) Auto-Call Unit
- (3) Modem
- (4) Coupler

The following paragraphs briefly describe these hardware elements:

Teleprocessing Multiplexer Module (TPMM) - The TPMM provides the communication interface logic for controlling up to eight asynchronous communication lines simultaneously. The TPMM also provides the interface to the System/7 for control of the communications with remote sites.

Auto-Call Unit - The Autocall Unit consists of a Western Electric 801 Autocall Unit and provides the interface with the TPMM for dial-up information and status. The Autocall Unit is an output-only device and performs automatic dialing of the remote sites as commanded by the System/7 via the TPMM.

Modem - The modem is a Western Electric 202C device which is compatible with the modem in the SDAS unit at the remote sites. The modem performs modulation/demodulation of signals being transmitted to/from the remote site.

Coupler - The coupler is a standard Western Electric device which provides voltage transient protection for the telephone lines.

1.3.1.3 Manual Data Collection (Cassette Read)

To support collection of data via manual means from remote sites, the communication interface configuration contains a prototype Site Data Acquisition Subsystem (SDAS). Cassette tapes manually retrieved from sites will be inserted into the prototype unit and transmitted to the System/7 via local telephone lines.

1.3.1.4 System/7 - Host Computer Communication (SBCA)

The Sensor Based Communication Adapter (SBCA) provides the capability for high-speed data transfer between the System/7 and the host computer. The SBCA will transfer data at a rate of 2.2 megabits per second.

1.3.2 Host Computer Configuration

The host computer configuration receives raw data collected from all remote sites, on a daily basis, via the communication hardware from the communication interface configuration. This data is then processed and stored into the performance evaluation data base for use in evaluation activities. The host computer configuration consists of an IBM System/370-145 which is shared with other users. The configuration is shown in Figure 3, and significant elements are discussed in the following paragraphs. Detailed descriptions are available in existing IBM equipment reference manuals.

1.3.2.1 Sensor Based Control Unit (SBCU)

The SBCU provides the communications medium for receipt of data from the communication interface configuration for processing. Data transfer rate is 2.2 megabits per second.

1.3.2.2 Terminal Support

IBM 3277 terminal units are provided for access/update of the performance evaluation data base. Two terminals will be dedicated to the solar energy applications to ensure availability. Tabular output can be displayed on these terminals.

A Tektronix 4015/4631 display hard copy unit provides the capability to generate either text or graphical data representative. This unit is dedicated to support of the analytical/reporting requirements of the program.

1.3.2.3 Magnetic Tape Units

The configuration provides both 9-track and 7-track magnetic tape handling capabilities. Density for 9-track tapes is 1600 BPI or 800 BPI; whereas, 7-track tapes are 800 BPI. The magnetic tape units will be used to generate deliverable tapes to MSFC for use in updating the MSFC solar energy data base and to other data users as required. In addition, archival data will be placed on magnetic tape for storage.

1.3.2.4 Disk Storage Units

The configuration provides IBM 3333/3330 disk units for use in supporting the performance evaluation data base. The present configuration contains storage capacity of 400 megabytes; however, the system supports expansion without hardware modification to 2 billion bytes of storage. One disk unit, which provides storage for 200 megabytes, will be dedicated to SIMS CDPS functions.

1.3.2.5 High-Speed Printers

Three high-speed Printers (1100 lines per minute) are provided for support of report generation/distribution requirements. In addition, reports created during processing of data will be printed for analysis.

1.3.2.6 Console

The operation console provides the operator with visibility into and control of operations within the computer. It will be used to allow the operator to initiate daily processing of data from remote sites. Status during processing and operator actions required will be presented on the console.

1.3.2.7 Mainframe

The Mainframe of the host computer consists of a memory capacity of 1 million bytes, input/output channels, and the Central Processing Unit (CPU). Memory utilization of approximately 256K bytes is anticipated in support of data processing functions; thus, significant margin (excess capacity) exists. The CPU provides the instruction set, memory addressing logic, registers, and input/output control functions required in support of software execution.

1.3.2.8 Operating System

The System/370 operating system is utilized to control the execution of data processing functions within the software. In addition, the operating system provides the language processors (compiler/linkage editors/etc.) used in generation of both the S/370 and System/7 software.

A processing priority system is utilized by the operating system to maximize computer utilization. To ensure that solar energy data is processed within specific time constraints, a high priority level will be assigned.

1.4 CDPS OVERALL SOFTWARE DESCRIPTION

Within the CDPS, the major software tasks to be performed are:

- o Communication Interface - for data collection
- o Input Processing - for conversion of raw data into information
- o File Maintenance - for updating/maintaining performance evaluation data base
- o User Support - for generation of outputs to satisfy the needs of the data user community.

As can be seen in Figure 4, the major software tasks have been allocated to CDPS hardware configurations. This allocation is based on the philosophy of the System/7 computer configuration's performing the data collection function and the host computer configuration's performing detailed data editing, data conversion, file maintenance, and user support functions.

Also shown in Figure 4 is the performance evaluation data base. This data base will contain all data required to support the performance analyst and will reside on disk storage and magnetic tapes within the host computer configuration.

Subsequent sections of this document define the detailed requirements which must be satisfied within the software elements and the data base.

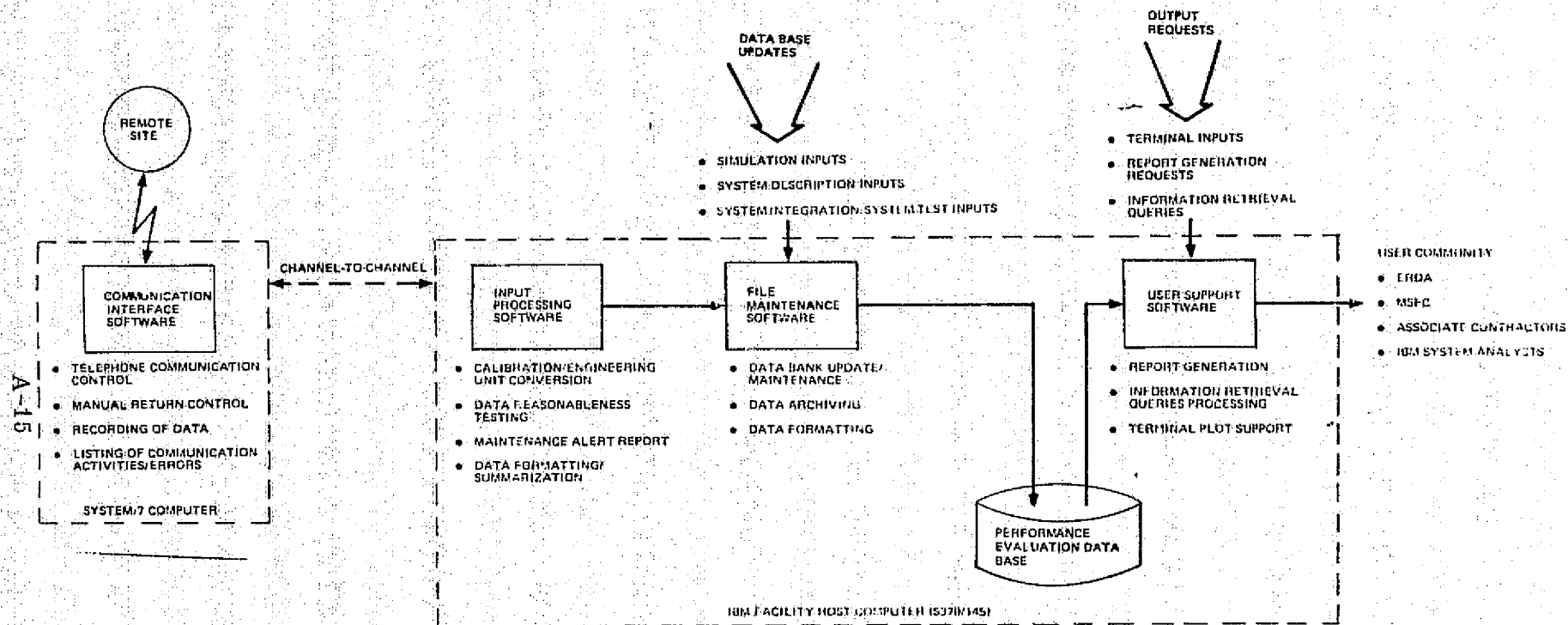


Figure 4. Major Software Tasks

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2.0 COMMUNICATIONS INTERFACE SOFTWARE REQUIREMENTS

The communications interface software will reside in a System/7 computer and provide the communications interface functions for the central data processing system.

The System/7 communications interface software will sequentially dial sites over switched asynchronous telephone lines and collect sensor data. A site directory on disk will be used to control the proper sequencing of site data collection. After data collection is complete the System/7 - host computer link will be used to transmit the data to the host for subsequent detailed processing and data base update.

2.1 FUNCTIONAL SOFTWARE REQUIREMENTS

The communications interface software shall provide communications with each SDAS, control the collection of SDAS sensor data, and send the data to the host computer. In order to meet these requirements, the following functional capabilities will be provided.

- o Access to Remote Sites via automatic telephone calling sequences contained within a site directory.
- o Control of communications signals to support a switched telephone interface to each SDAS.
- o Control of each SDAS over telephone lines for data collection.
- o Temporary buffering and disk storage of the data from each SDAS.
- o Transmission of SDAS data to the host computer.
- o Manual control of SDAS commands for troubleshooting.

The detailed software requirements associated with each of the above functions are presented in the following paragraphs:

2.2 SITE DIRECTORY REQUIREMENTS

A site directory containing information on each site shall be provided for the communications interface software to control the data collection process. This information shall be maintained on the System/7 disk to insure data integrity during power off conditions.

2.2.1 Site Directory Information

Information in the site directory is required for each site. The information shall be organized on disk by site records and fields of data. Each site shall have a record of information that contains fixed data fields. Each field of SDAS information required will be described in the following paragraphs:

2.2.1.1 SDAS Station Address

This field shall contain the unique station address associated with each site. This field will be used to obtain the station address for SDAS command messages described in Section 2.4.1.

2.2.1.2 SDAS Status

This field shall provide the operational status of each SDAS. It shall be modified by the communications interface software as each site is called, commands sent to the SDAS, and data collected. The status field will allow proper sequencing during a restart of the data collection process.

2.2.1.3 SDAS Dial Digits

This field shall contain the autocal dial digits required to automatically call a site over switched lines. These digits shall be entered by an operator when the remote site becomes operational and shall remain fixed thereafter.

2.2.1.4 SDAS Process Requirements

This field shall specify how often data will be collected from a site. It will contain the number of days desired between data collections. A "1" in this field for instance would indicate daily collection. This field shall initially be input by an operator when the site becomes operational and shall be changed only if collection requirements change.

2.2.1.5 SDAS Data Collection Time

This field shall be required by the communication interface software to determine when data is to be collected from a site. It shall contain the time (year, day, hour, min, sec) that data was last

collected. By subtracting this field from the current time and comparing the result with the SDAS process requirements field, the software shall automatically determine when to collect data from a site.

2.2.1.6 SDAS Error Information

This field shall contain error information received from a site during data collection. Error information is contained in the reply message from a site and is described in Section 2.4.2.3.

2.2.1.7 Number of Site Disk Extents

Data collected from each remote site shall be temporarily stored on disk until forwarded daily to the host computer for processing. To provide the flexibility to continue the collection from sites when either the data transfer link (SBCA) or the host computer is not functioning, the software shall allow provisions for up to five daily collections before data transfer to the host must be accomplished. This field of the site directory shall indicate the number of times data has been collected since last transfer to the host computer. Upon completion of data transfer, this field shall be reset to indicate that no data is being retained on the disk.

2.2.1.8 Site Record Index

This field shall indicate where the data collected from a site is stored on disk. This field shall have the capability to contain five entries due to the collection requirement specified in 2.2.1.7.

2.2.1.9 Site Byte Count

This field shall indicate how many bytes of data were collected and, when used with the field specified in 2.2.1.8, will indicate where data was stored on disk and how much data was stored. This field will hold up to five entries (one for each possible data collection).

2.2.1.10 Initial Real Time Clock Reading

This field is required in order to determine the actual local time of sensor readings in the collected data. It shall contain the time (year, day, hour, min, sec) in local time that the Real Time Clock in each SDAS read zero. This field shall hold five entries (one for each possible data collection).

2.2.1.11 BCH Errors

This field shall indicate the number of BCH errors detected during each data collection (five entries shall be provided). BCH error processing is discussed in Section 2.3.2 of this document.

2.2.2 Site Directory Update Requirements

The ability to manually update the site directory from the System/7 teletype shall be provided. The fields which shall be updated are:

- o SDAS Dial Digits
- o SDAS Process Requirements

All other fields shall be updated under program control during data collection and subsequent transmission to the host.

2.2.3 Site Directory Print Requirements

All the site directory fields described in section 2.2.1 shall be printed, either upon request or when the site directory is initially generated. This function will not be done on-line during data collection but shall be initiated as an off line program.

2.3 COMMUNICATIONS HARDWARE INTERFACE REQUIREMENTS

In order to automatically collect data from remote sites, software shall be provided to communicate with each SDAS via the communications hardware. Figure 5 shows the communications hardware with which the software shall interface. The software shall initiate commands to the Teleprocessing Multiplexer Module (TPMM) to establish proper communications to the autocall unit and modem for both transmission to and receipt of data from the SDAS. In addition, the software shall perform status checking after every input/output operation to ensure correct operation. The following paragraphs define the detailed requirements to be satisfied in interfacing with the communication hardware.

2.3.1 Interface Command Requirements

Interface commands and required software action to initiate communication operations are shown in Table 2-1.

Table 2-1. Interface Commands/Software Required Actions

COMMAND	SOFTWARE ACTION
OPEN A LINE	Initialize a communications line for asynchronous send/receive operations or a dial operation
CLOSE A LINE	Place a communications line in the inactive state.
DIAL A REMOTE SITE	Automatically issue dial digits to the Bell 801 autocall unit and complete a connection to a site over a switched telephone line.
ISSUE SDAS COMMAND	Transmit data (SDAS commands) over an asynchronous communications line and then receive data (SDAS reply) over the same asynchronous communications line.

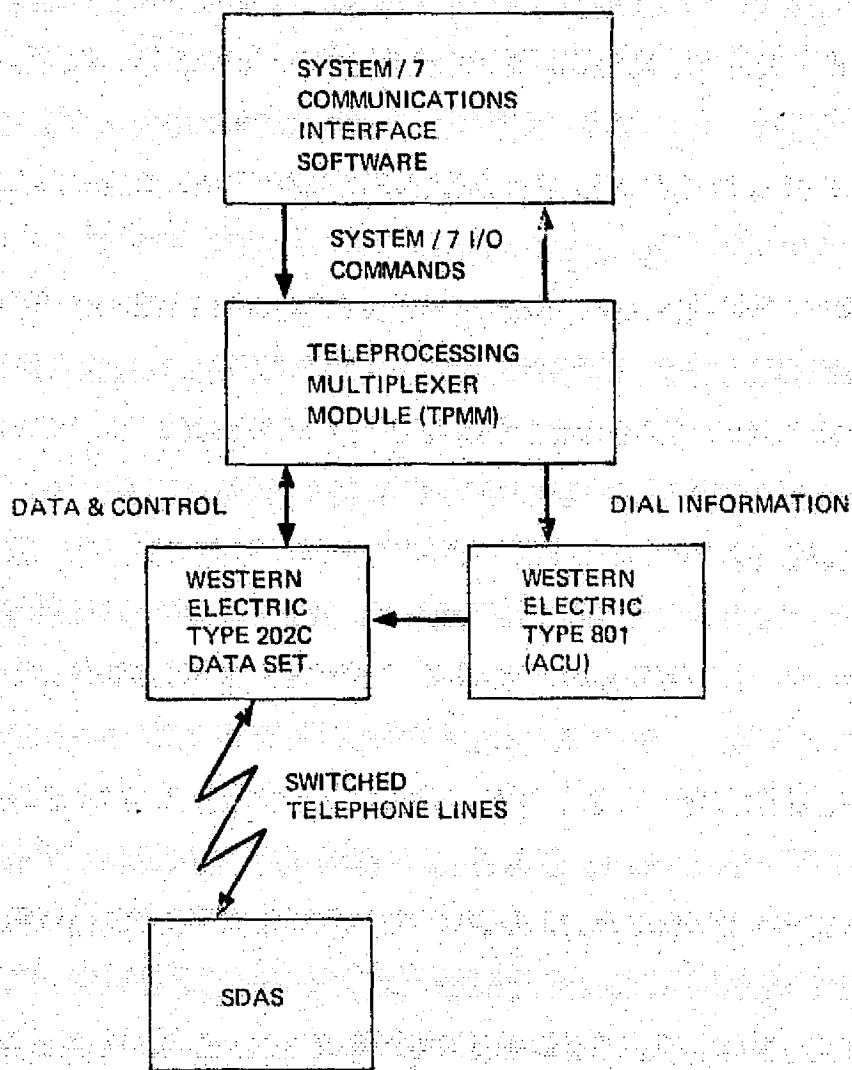


Figure 5. Communication Interface Hardware

2.3.2 Data Integrity Requirements

A validity check shall be required on all data sent or received over the communication system. This validity check will be sent/received every eight bytes as part of the data and will provide a data integrity check down to eight bytes.

The method of validity checking shall be a cyclic redundancy code method called Base-Chaudhuri-Hocquenghem (BCH). A BCH shall be calculated and sent with all data transmitted to a SDAS. The SDAS will calculate a BCH for the data received and verify the BCH sent is the same value. If the value is not the same, an error reply message (as defined in Section 2.4.2) shall be sent to the System/7. A similar verification shall take place in the communications interface software in the System/7 for all data received from the SDAS. Action taken by the System/7 software for error conditions is discussed in Section 2.4.2.

2.3.3 Communications Hardware Status Requirements

During each interface command specified in Section 2.3.1, status checking shall be performed and status information made available after the operation. The types of errors required to be detected and required software actions are defined in Table 2-2.

Table 2-2. Communication Error Detection/Software Action

ERROR STATUS	SOFTWARE ACTION
Data Set Check - o Loss of Data Set Ready during a read - o Loss of Carrier Detect during a read - o Loss of Clear to Send during a write - o ACU not ready during a dial	Make three attempts to reestablish communications and retry the command. If unsuccessful, continue to next site
Data Overrun o Character interrupt occurred before previous character serviced	Retry command three times, then continue to next site
System/7 XIO Error	Retry command three times, then continue to next site
Time Out Between Characters	Make three attempts to reestablish communications and retry the command. If unsuccessful, continue to next site*
Time Out - No SDAS Reply	Make three attempts to reestablish communications and retry the command. If unsuccessful, continue to next site*
BCH Error in Received Data 1 error for all commands other than "Read Tape." 10 errors for "Read Tape."	Retry command three times then reestablish communications and retry three times then continue to next site*
Software Error	Stop**
* If we have three failures to complete a data transmission, the program will force a save of data collected during the third try.	
**System recovery shall be under operator control (reload of system and restart/contact System/7 programmer)	

2.4 SYSTEM/7 - SDAS COMMUNICATIONS REQUIREMENTS

The System/7 communications software shall initiate all communications with a site. Each site communications shall be initiated with a command message from the System/7 and be followed by a reply message from the site. Figure 6 illustrates the communications command/reply sequences necessary to collect sensor data from a site. The following paragraphs describe the System/7 - SDAS communications requirements.

2.4.1 Command Message Processing

Upon establishing communications with a remote SDAS via the communications hardware (described in paragraph 2.3), the communications software shall transmit a command message to the SDAS. Each command message shall contain:

1. A unique command code for the SDAS function to be performed
2. SDAS identification information
3. BCH code for data validity checking

The format of the command message is discussed in paragraph 2.4.4. After transmission of the command, the software shall delay for at least one minute awaiting a reply message from the SDAS. If no reply is received within the time limit, the communications software shall disconnect from the telephone line, print a message indicating failure to respond, and attempt to reestablish the command interface. The software shall attempt to establish communications three times. If not successful, a message shall be printed indicating unsuccessful communications, and the software shall proceed to the next remote site.

2.4.2 Reply Messages Processing

A reply message shall be sent to the System/7 from the SDAS after each successfully received command message. Reply messages shall vary in length depending on the command which was transmitted to the SDAS; however, each reply message shall contain the following information:

1. Command Code (as received by SDAS)
2. Site Identification (as received by SDAS)
3. Status of the SDAS
4. BCH Code generated by SDAS for data validity checking.

Format of the Reply Message is discussed in Paragraph 2.4.5.

Two types of Reply Messages shall be received from the SDAS:

Normal Reply Message - Bit 0 of the SDAS status code contains a "0".

CODE 20254
87933251

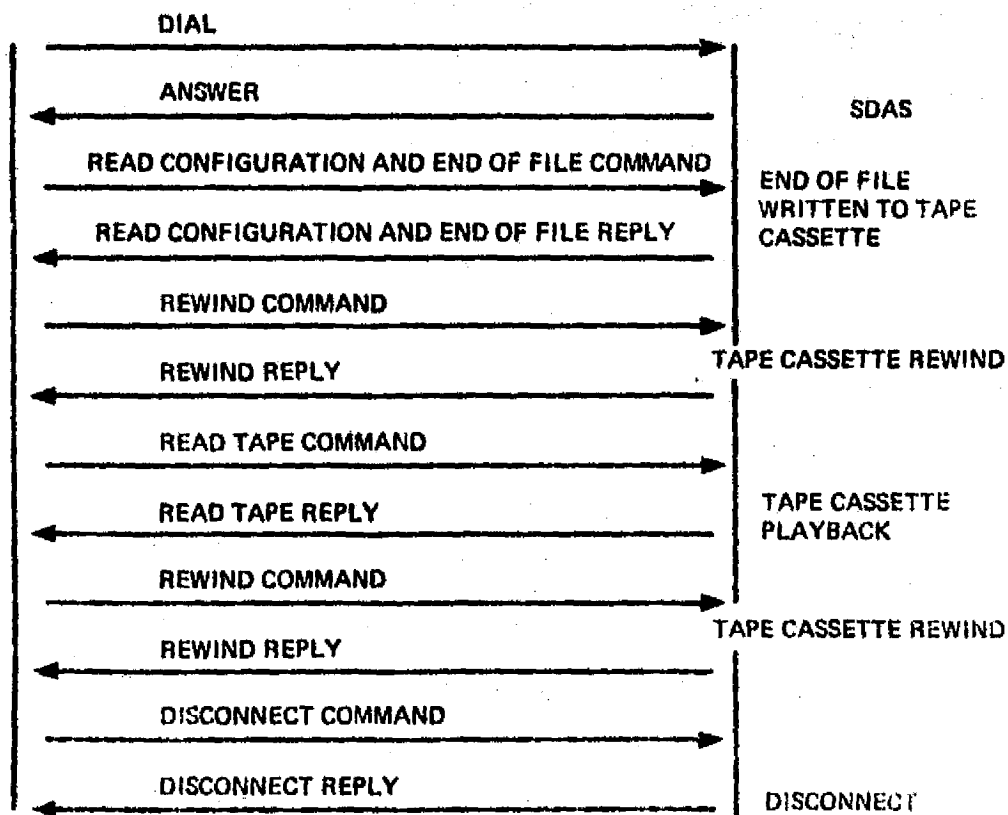


Figure 6. Command/Reply Sequence

Error Reply Message - Bit 0 of the SDAS status code contains a "1".

Upon receipt of a Reply Message, the software shall determine the type of reply and perform the processing functions required for the type. These processing requirements are discussed in the following paragraphs.

2.4.2.1 Normal Reply Processing

The software shall examine the status and BCH codes returned with the reply message. If the BCH returned with the data does not agree with the BCH calculated for the data, the software shall repeat the command sequence up to three times. If the reply data is incorrect for three consecutive attempts, a message shall be printed, communications shall be reestablished and three more attempts made. If still unsuccessful, the software shall proceed to the next site for continuation of data collection.

If the status returned indicates an SDAS error, the message reply is considered an error reply message and the actions specified in section 2.4.2.2 shall be performed.

For normal reply messages which pass BCH and status tests, the software shall proceed to the next command in the site data collection sequence.

2.4.2.2. Error Reply Message Processing

The error reply message shall contain status codes indicating the error which exists within the SDAS. These errors, with the corresponding required software action, are shown in Table 2-3.

Table 2-3. SDAS Error Conditions and Software Action

Error Condition	Software Action
1. BCH Error in Previous Command	Reissues command to SDAS (3 times, if required) then continues to next site
2. Invalid Command Received	Reissues command to SDAS (3 times, if required) then continues to next site
3. Invalid Station Address Received	Reissues command to SDAS (3 times, if required) then continues to next site.
4. SDAS Devices Failures - o MPX 1 - o MPX 2 - o MPX 3 - o AI Basic - o Tape Control - o Realtime Clock	A message containing the status received is printed and the software proceeds to the next site. The SDAS error information is placed in the site directory field specified in Section 2.2.1.6

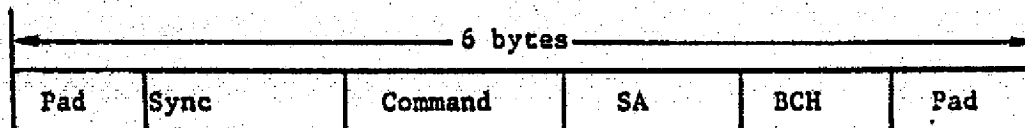
2.4.3 Command Definitions

The communications software shall support the commands to the SDAS as shown in Table 2-4. The actions taken by both the SDAS and the communications software in accomplishing the command function are also shown.

Table 2-4. System/7-SDAS Commands/Software Action		
COMMAND	SDAS ACTION	REPLY ACTION
Read Configuration & End-of-File	End of file written to tape cassette and reply message with current Realtime Clock (RTC) reading sent to System/7	System/7 computes when SDAS RTC was initially "0" and proceeds to next command
Rewind/Read	Tape cassette is re-wound to beginning of tape and reply sent to System/7	Reply message verified and next command issued
Read Tape	Tape cassette is placed in play mode and data on cassette sent as reply message	Tape cassette data is read, BCH checked, & stored on disk
Disconnect	Reply message sent to System/7 and SDAS disconnected from communications	Reply message verified- any new command must dial to reestablish communications with SDAS
Disconnect & Rewind**	Reply message sent to System/7, SDAS disconnected from communications, and tape cassette rewound	Reply message verified- any new command must dial to reestablish communications with SDAS
Read Configuration*	Reply message sent to System/7 with current SDAS RTC reading	Reply message verified
Reinitialize**	Reply message sent to System/7 and a master reset of SDAS hardware and software executed	Reply message verified
Rewind only**	Tape cassette rewinds until stop is encountered and reply sent to System/7	Reply message verified
*This command useful for verifying status of SDAS **Not used during operational data collection.		

2.4.4 Command Message Format

All command messages shall have the following format:

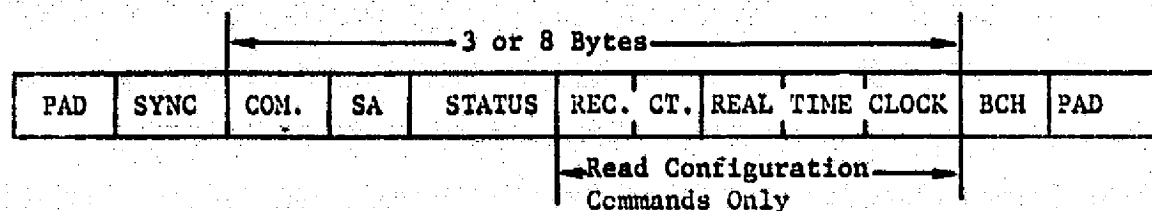


Pad - FF Circuit Activation Bits - 1 byte
 Sync - 6C Synchronization byte
 Command - HH* Unique command code
 SA - HH Station Address - SDAS Identification Code
 BCH - HH Block Check Code for previous two bytes

*H - Hexadecimal digit - 4 bits

2.4.5 Reply Message Format

All reply messages with the exception of the Read Tape reply shall have the following format.



Pad - FF Circuit Activation Byte - 1 byte
 Sync - 6D Synchronization Byte
 Command - HH* Command Received
 SA - HH SDAS Station Address
 Status - HH SDAS Status
 Record Ct. - HHHH Unused
 Real Time Clock - HHHHHH 24 Bit SDAS Real Time Clock Reading

BCH - HH Block check clock for previous 3 or 9
bytes depending on reply

*H - Hexadecimal digit - 4 bits each

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2.4.6 Read Tape Reply

The Read Tape reply contains data transmitted from the cassette tape in the SDAS. This reply message shall vary in length depending on the amount of sensor data on the tape. The format of the Read Storage Table reply is shown in Figure 7.

2.4.7 Communication Report Requirements

During the System/7 - SDAS communications required for data collection an operational log or report shall be generated. This report shall maintain a history of each site command/reply activity and shall contain the following:

- o Time information with each message
- o Commands sent to SDAS
- o Status information associated with each command
- o Action taken after errors

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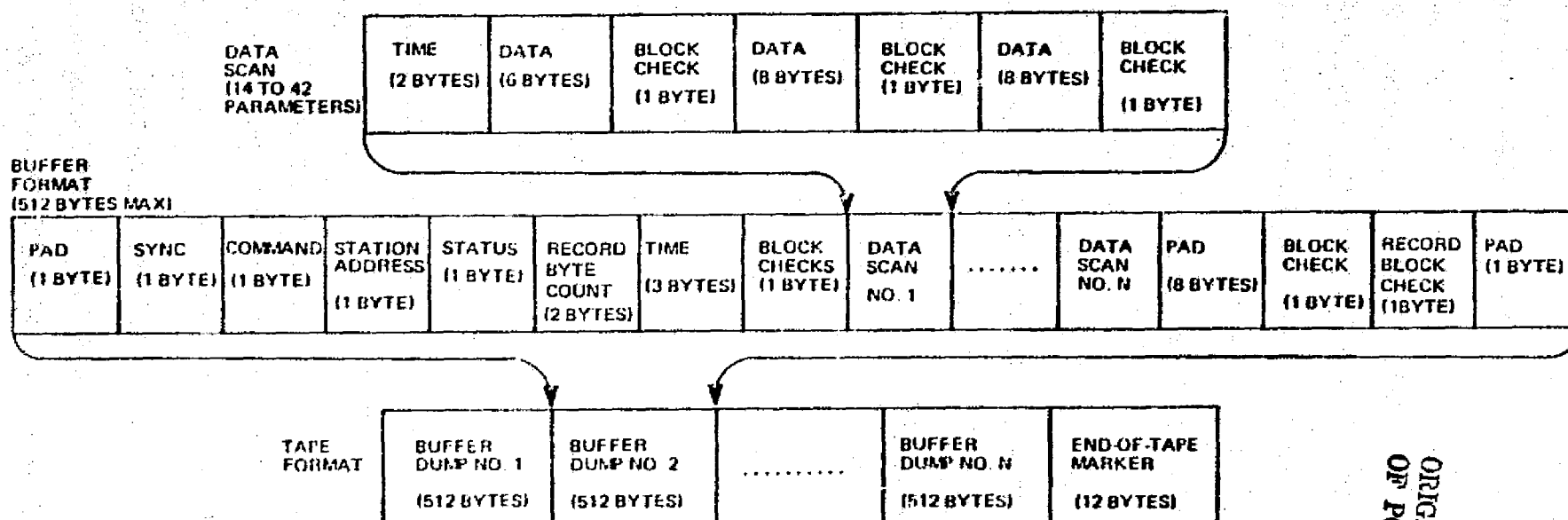


Figure 7. Read Tape Command Reply Format

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2.5 DATA STORE REQUIREMENTS

The communications interface software shall accept and store on disk all incoming SDAS sensor data. This data will be received as the reply to a Read Tape Command and will be in the format described in Section 2.4.6. The data store software shall provide the following:

- o Buffers in System/7 memory to accept the data transmitted from the SDAS. Two separate, chained buffers will be required to allow one buffer to accept data while data is being written to the disk from the other.
- o Provide storage (non-volatile) of the data on System/7 disk
- o Maintain the Site Directory fields that provide an index to the data on disk.
- o Maintain the local time that the data was collected

2.6 TRANSMIT DATA TO HOST COMPUTER

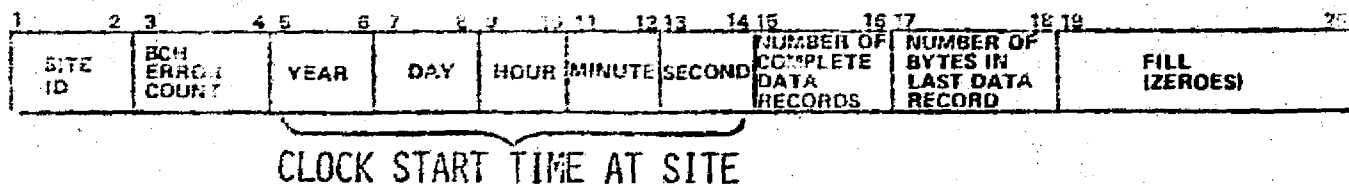
The communications interface software shall provide a host forward store capability. This software shall perform the following:

- o Automatically retrieve the sensor data for each site from the System/7 disk.
- o Build an identification/header record to be sent to the host with the data from each site.
- o Update the Site Directory fields on System/7 disk.
- o Transmit the header records and data from site to a data set on the S370-145 host computer.
- o Provide error recovery during System/7 - HOST data transfer.

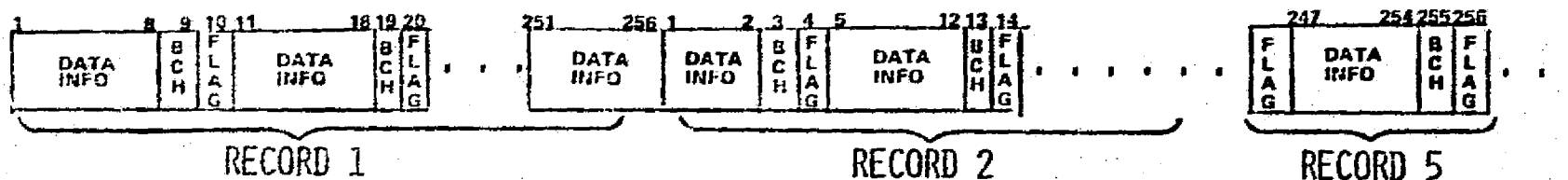
The required format of the header records and data to be sent to the host are shown in Figure 8.

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ID RECORD



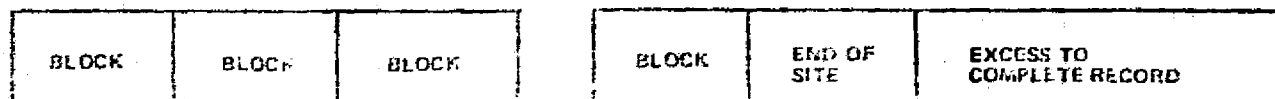
DATA RECORDS



BCH - BLOCK CHECK CHARACTER

FLAG - INDICATES WHETHER THERE WERE ERRORS IN THE PRECEDING 8 BYTES OF DATA

DATA INFO



(BLOCKS ARE ALIGNED TO BEGIN ON A BYTE AFTER A FLAG BYTE)

Figure 8. System 7 Output Format

END OF SITE

1	2	3	4	8
COMMAND CODE E1 ₁₆	SA	SC	FF ₁₆	

(END OF SITE IS 8 BYTES LONG, AND BEGINS AFTER A FLAG BYTE)
SA IS STATION ADDRESS / SC IS STATUS CODE

BLOCK

BLOCK START COMMAND SCAN	SCAN	SCAN	SCAN		SCAN	END OF BLOCK 8 BYTES OF FF ₁₆	MORE FF'S UP TO NEXT BCH BYTE
-----------------------------------	------	------	------	--	------	--	-------------------------------------

(BLOCK STARTS ARE ALIGNED AFTER A FLAG BYTE, SCAN'S ARE NOT ALIGNED, END OF BLOCKS ARE NOT ALIGNED BUT MAY BE PADDED WITH EXTRA FF'S.)

BLOCK START COMMAND

1	2	3	4	5	6	8
COMMAND CODE E0 ₁₆	SA	SC	BLOCK COUNT	TIME		

TIME IS A COUNT IN 2 SECONDS ELAPSED SINCE CLOCK
START TIME AT SITE. TIME AT START OF BLOCK.

SCAN

1	2
TIME	SCAN DATA: LENGTH AND ARRANGEMENT DEPENDS ON SITE

TIME IS LEAST SIGNIFICANT 2 BYTES OF COUNT
IN 2 SECONDS ELAPSED SINCE CLOCK START
TIME AT SITE.

2.7 MANUAL SDAS CONTROL REQUIREMENTS

The ability to manually select and send commands to the SDAS and monitor the reply shall be provided as an aid in troubleshooting SDAS or system anomalies. This capability shall also be used in initially bringing a site on line. The commands provided as operator input from the System/7 teletype shall be as follows:

- o Reinitialize
- o Read Configuration
- o Read Configuration and End of File
- o Disconnect
- o Rewind
- o Disconnect and Rewind
- o Read Tape
- o Rewind with forward read to BOT

The reply from the SDAS and the communication hardware status shall be printed after each command. Printing of the data received from the "Read Tape" command (data written on cassette) shall be under control of the operator.

3. INPUT PROCESSING SOFTWARE REQUIREMENTS

The input processing software, as shown previously in Figure 4, executes in the S/370-145 host computer configuration. The overall function of this software element is to transform raw input into processed information for generation of the performance evaluation data base. This transformation requires that the software satisfy the requirements as stated in the following paragraphs.]

3.1 FUNCTIONAL REQUIREMENTS

The input processing software, in performing its data processing role within the CDPS, shall perform the following:

- o Accept raw site data from the System/7.
- o Extract variables from scans and convert to engineering units.
- o Test converted variables in accordance with performance analyst inputs.
- o Compute performance evaluation parameters.
- o Generate site operational data base files.]
- o Create history/archive tapes.
- o Create input summary reports and error messages.

The detail requirements associated with above functions are described in the following paragraphs:

3.2 ACCEPT RAW DATA FROM THE SYSTEM/7

Software on the S/370 shall communicate with the host forward store software on the System/7 for the transfer of raw data. Communication shall be through a Sensor Based Control Unit (SBCU) attached to the S/370 to a Sensor Based Control Adapter (SBCA) attached to the System/7. Raw data received from the System/7 shall be stored into a S/370 data set on disk for subsequent processing. The input format from the S/7 was shown previously in Figure 8, and the format of the data on the S/370 data set shall be identical to the input. Data shall not be passed to subsequent processing steps if errors are encountered during data transmission. Data transfer shall be attempted five times if errors occur. If transfer is unsuccessful after five tries, the customer engineer shall be notified.

Error conditions which shall be detected during the transfer are shown in Table 3.1.

Table 3-1. System/7 - Host Communication Error Conditions

Error Conditions	Required Actions
1. Channel Control Check	1. Message issued to console. Retry of transmission will depend on sense settings associated with error.
2. Interface Control Check	2. Message issued to console. Retry of transmission will depend on sense settings associated with error.
3. Chaining Check	3. Message issued to console. No retry.
4. Channel Data Check	4. Message issued to console. Retry response on sense settings associated with error.
5. Command Reject	5. Message issued to console. One retry performed.
6. Bus Out Check	6. Message issued to console. One retry performed.
7. Equipment Check	7. Message issued to console. Five retries performed.
8. Data Check	8. Message issued to console. No retry performed.
9. Overrun	9. Message issued to console. No retry performed.
10. Controller Read Timeout	10. Message issued to console. One retry performed.
11. End of Block Response Timeout	11. Message issued to console. No retry performed.
12. Incomplete Read Operation	12. Message issued to console. No retry performed.
13. Invalid Controller Address	13. Message issued to console. No retry performed.
14. Incomplete Sense SBCU	14. Message issued to console. No retry performed.
15. Invalid Order Response	15. Message issued to console. No retry performed.
16. Invalid Branch	16. Message issued to console. No retry Performed.

Table 3-1. System/7 - Host Communication Error Conditions (Continued)

Error Conditions	Required Actions
17. Invalid End-of-Block Response	17. Message issued to console. No retry performed.
18. Invalid Attention Response	18. Message issued to console. No retry performed.
19. No Controller Selected	19. Message issued to console. No retry performed.
20. No Request Code	20. Message issued to console. No retry performed.
21. Order Response Timeout	21. Message issued to console. No retry performed.
22. Request Code Overflow	22. Message issued to console. No retry performed.
23. ALU Check	23. Message issued to console. No retry performed.

3.3 DECOMMUTATE RAW DATA INTO SCANS

Decommutating raw data into scans shall include:

- o Separating BCH's and flags from the data.
- o Determining the location of Block-Starts, End-of-Blocks, and End-of-Sites.
- o Extracting scans from the data.
- o Computing scan times in local time at the site.

Error processing shall include:

- o Stopping the processing for a site if the program cannot locate where blocks and scans begin and end. An error message shall also be printed indicating that data has been rejected.
- o Storing a scan into a rejected-scan data set if the time of the scan is uncertain because of BCH error or the time fails time continuity tests. An error message shall also be printed indicating time of scan and reason for rejection.

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3.4 EXTRACT VARIABLES AND CONVERT TO ENGINEERING UNITS

The input processing software shall process variable formats for data variables within scans. The software shall maintain a SDAS description directory to provide a detailed definition of the location of each variable within each SDAS input data stream.

To extract variables from scans, the scan file created during decommutation shall be used as input. The software shall locate each variable requiring calibration/conversion through use of the SDAS description directory.

Variables shall be calibrated and converted to engineering units using the contents of the IP & C (Instrumentation Program and Components List) file for conversion type and the conversion constants for each variable. The following conversion types shall be provided.

Linear:	Eng-Units = $A + (B \times \text{Raw})$
Quadratic:	Eng-Units = $A + (B \times \text{Raw}) + (C \times \text{Raw}^2)$
Third Order:	Eng-Units = $A + (B \times \text{Raw}) + (C \times \text{Raw}^2) + (D \times \text{Raw}^3)$
Discrete:	Eng-Units = 1 if $A \leq \text{Raw} \leq B$ 0 otherwise
Root:	Eng-Units = $\sqrt{A + (B \times \text{Raw})}$

3.5 CONVERTED VARIABLE TESTING

After conversion to engineering units, individual variables shall be tested for:

- o Exceeding limits specified by the performance analyst
- o A change between successive readings which exceeds a maximum specified by the performance analyst
- o A DCH error flag for the portion of the data stream from which the variable was extracted.

A variable which fails any of the above tests shall be rejected. A failure indication value shall replace the computed value in the output used to update the data bank. The rejected computed value, along with identifying information (site id, time, and an indication of which variable the data is for) shall be included in error messages/reports to the analyst.

The capability shall be provided to perform tests for no change in a variable. This capability shall be selectable via performance analyst input. Variables failing this test shall be included in error messages provided to the analyst.

Control over the level of detail of error messages shall be provided to the analyst. Capability shall provide detail messages (to the variable level), summary messages, or no messages.

3.6 COMPUTE PERFORMANCE EVALUATION PARAMETERS

The input processing software shall utilize the site instrumentation data and manually provided data to compute performance evaluation parameters. Instrumentation input to these computations shall consist of input variables at the scan level after conversion to engineering units and testing functions have been performed. Manual input of parameters required in computation of performance parameters shall be provided by the performance analyst. The resulting performance parameters shall be included as output for entry into the data base.

The following performance evaluation factors are typical of what might be required for a particular site. This is not an all inclusive list and is presented only for illustration. The particular list computed is site dependent with some amount of addition or deletion to be expected.

- o Solar Energy Proved for Hot Water

The solar energy applied to the hot water load over the time period of interest. The DHW storage tank output differential temperature and the DHW flow to load would be utilized to calculate this energy transfer. This calculation is in the form of an integral with integration interval corresponding to the summary time period.

- o Auxiliary Energy Required for Hot Water

The auxiliary power transferred to the hot water when solar energy cannot meet the demand. Differential temperature across the DHW auxiliary heat exchanger and flow to DHW load is utilized in an integral equation to calculate the energy function.

- o Energy Savings for Hot Water

The fossil fuel equivalent energy savings that result from using solar energy to heat the domestic water. This is accomplished by subtracting the fossil fuel equivalent energy required to operate the solar system from the equivalent fossil fuel energy which would be required to operate a conventional system to satisfy the same load. The user must supply the thermal efficiency for converting fossil energy into energy required to operate the conventional subsystem selected for comparison.

- o Solar Energy Required for Heating

The energy from the solar energy system utilized for space heating. The differential temperature on the load side of the storage tank together with the flow to load from storage are utilized in an integral equation.

o Auxiliary Energy Required for Heating

Auxiliary energy for space heating may be supplied either electrically or thermally. The electrical option requires totalized wattmeter readings that are then converted to Btu's. The thermal option is calculated in a similar manner as the auxiliary energy for hot water with the differential temperature being across the space cooling/heating auxiliary energy heat exchanger and the flow measurement being the flow through the heat exchanger.

o Energy Savings for Heating

The fossil fuel equivalent energy savings from using solar energy for space heating computed by subtracting the fossil fuel equivalent energy required to operate the solar system space heating system from the equivalent fossil fuel energy required to operate a conventional system to satisfy the same load. The user must supply the thermal conversion efficiency and COP for conventional subsystem selected for comparison.

o Solar Energy Required for Cooling

The energy from the solar energy utilized for cooling. An integral equation similar to the solar contribution to space heating where the differential temperature on the load side of storage and flow to load refer to chiller operation.

o Auxiliary Energy Required for Cooling

An integral equation similar to the auxiliary thermal energy required for space heating with temperature differential and flow measurements referring to chiller operation.

o Energy Savings for Cooling

The fossil fuel equivalent for using solar energy to provide cooling. Computed in manner similar to the hot water and space heating with user supplying the thermal conversion efficiency and COP for conventional subsystem selected for comparison.

o Rotating Equipment Power

The total power required by components such as pumps and fans which are required to operate the solar energy system.

o System Energy Loss

The energy collected by the array but not utilized by the heating, cooling or DHW subsystems. It is the difference between the solar energy collected and utilized and a correction term applied to account for the variation in energy storage.

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o Total Solar Utilized

The sum of the solar energy system contribution to DHW, heating and cooling.

o Total Auxiliary

The sum of the auxiliary energy required to support the solar energy system for DHW, heating and cooling.

o Total Load

The useful effect provided to the building by the DHW, heating, and cooling subsystems. For some types of subsystems this value will be identical to the sum of the solar energy used and the auxiliary energy used while for others this sum must be modified to account for the efficiency of the subsystem.

o Total Percent Solar

The portion of the heating, cooling and DHW load (total load) provided by solar energy and expressed as a percent. It is calculated by dividing the sum of the solar energy applied to the heating, cooling and DHW load by the total load.

o Total Energy Saved

The sum of the fossil fuel equivalent savings through use of solar energy for the various solar energy systems.

o Insolation Data - Incident

The numerical integration, over the time interval of interest, of the solar radiation falling upon the plane of the collector.

o Insolation Data - Collected

The amount of solar energy collected in a given time period obtained by evaluating the integral equation that requires the differential temperature between collector array fluid inlet and outlet and the collector array fluid flow rate. Correction for fluid specific heat variations may be supplied as deemed desirable.

o Insolation Data - Conversion Efficiency

This term expressed as a percent is a measure of the ability of the overall solar system to convert incident solar radiation into useful thermal energy for the building. It is determined by the ratio of load satisfied by solar energy to the total solar energy incident on the solar collector array.

o Collector Data - Array Efficiency

This term expressed as a percent is a measure of the ability of the solar collector to convert incident solar radiation into thermal energy available either for storage or for the building demand. It is determined by the ratio of solar energy collected by the array to the total solar energy incident on the array.

o Collector Data - F_{RUL}

This term is a measure of collector panel steady state thermal performance and represents the slope of a computed function that relates collector array efficiency to the difference between collector fluid outlet temperature and ambient temperature divided by incident insolation.

o Collector Data - $F_R(\tau\alpha)$

A measure of collector panel steady state performance and represents the y intercept of the function used to compute F_{RUL} .

o Storage - Loss

This parameter is a measure of performance of the storage container insulation and is related to the average temperature difference between the storage medium and the storage ambient. It is calculated by taking the difference between the energy input to storage and energy output to meet building demand and the change in the internal energy of storage. Energy input and energy output are integral equations requiring differential temperatures and flow rates on all closed fluid loops on the inlet and outlet. The change in storage energy is a function of the mass of the storage and the average temperature change over the time of interest.

o Storage - Efficiency

Utilizes the same computed parameters as storage loss and combines them to form a percentage. The ratio is defined as the energy removed from storage plus the change in energy of storage divided by the energy input to storage.

o Equipment COP

Measurements of the Coefficient of Performance (COP) are desired for thermally actuated equipment such as absorption chillers, heat pumps, etc. The equation used is dependent on the particular equipment being evaluated. For a typical absorption chiller it consists of the ratio of the cooling load met by the chiller

divided by energy required to meet the load (solar + auxiliary + rotating equipment).

o Diffuse Radiation

For some systems, it will be desirable to obtain a direct measure of the diffuse insolation for collector evaluation and therefore the appropriate instrumentation will be provided. Concentrating and spectral or angular selective collectors are examples of when this data is of value. Sampled values of the diffuse radiation will be taken and integrated over the time interval of interest.

In the computation of the performance parameters, use of any instrumentation variable which has field testing criteria will require a significant amount of input value deviance to determine if the value is set to an invalid indication (for example, sums require a minimum of 10 good values within an hour at this time). A different unique value will be used to indicate that this variable is not applicable to the computation.

3.7 GENERATE DATA BASE

The input processing software shall generate the data base. These records shall contain directly-instrumented variables and performance evaluation parameters. Each data element of a record shall contain either

- (1) A value which has passed testing criteria or
- (2) An indication that the value does not apply, was rejected, invalid or was not computed because of rejection or non-existence of an input value.

Data base records shall consist of:

- (1) Detail Records (measurement scan level)
- (2) Hourly Data (performance parameters)
- (3) Daily Data (performance parameters)
- (4) Monthly Data (performance parameters)

The requirements associated with the generation of these data are discussed in the following paragraphs.

Detail Data

These data shall be at the scan level (baselined at 5 minutes). All variables which either are not applicable to this SDAS or have failed processing testing shall be flagged with indicator fill words.

Hourly Data

Hourly data shall be computed from the detail data described previously. The hourly value (total or average) for a parameter shall be computed using an appropriate method (for example, rectangular integration) based on the valid detail (scan) value for appropriate variables within the hour. If a significant number of values of the variables within the hour have failed testing criteria (as indicated by the appropriate fill words), or are not applicable the hourly value shall be set to the appropriate fill value.

Daily Data

Daily data shall be computed from the hourly data. The daily value (total or average) for a parameter shall be computed using an appropriate method (for example, rectangular integration) based on the valid hourly values within the day. If all hourly values have been set to an

appropriate fill word, then the daily value shall be set to that fill word, also.

Monthly Data

Monthly data shall be computed from the daily data using the same criteria that was used to determine daily values.

3.8 CREATE HISTORY/ARCHIVE TAPES

The input processing software shall provide the capability to create history/archive tapes of raw and processed data.

The software shall provide the capability to save on history/archive tapes the raw data received from the System 7 computer and SDAS data description information used in processing the raw data into engineering units.

The input processing software shall provide the capability to save processed data on tapes for history purposes as follows:

- 1) Detailed measurement data (raw data converted to engineering units for each scan) for all sites will be archived. Approximately one month duration of detailed measurement data for a group of approximately 20 sites will be archived on one tape.
- 2) Hourly performance factor data for all sites will be archived. Approximately three months of hourly performance factor data for a group of approximately 20 sites will be archived on one tape.
- 3) Daily and monthly performance factor data for all sites (approximately 200) will be archived every month on one tape.

The archived data shall be organized by site identification for retrieval purposes.

3.9 CREATE INPUT SUMMARY REPORTS AND ERROR MESSAGES

To assist the performance analyst and data base maintenance personnel, the Input Processing Software shall create input summary reports and error messages. To provide these reports and messages, the software shall:

- o Generate daily reports to specify the number of data base records by site and scans.
- o Generate a report to specify the number of records by site placed in data base detail record history files.
- o Generate a daily summary report to specify the number of SDAS's processed and the number of SDAS's for which processing failed.
- o Generate daily messages if a site is dropped or a block of data is dropped.
- o Support user selection options for SDAS summary reports on raw input processing. These reports shall include the following types of information:
 - Number of blocks
 - Number of scans
 - Time of first and last scan
 - Summary of errors in variables.
- o Support user selection for error messages on individual variable errors (BCH errors, out of limits, variable changing too fast, variable rejected) during raw input processing.
- o Support user selection option for printing data base detail records created by raw input processing.
- o Provide a report of calibration/conversion parameters for each remote site. Report shall include calibration/conversion data for each input parameter.

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4. FILE MAINTENANCE SOFTWARE REQUIREMENTS

The file maintenance software shall execute in the S/370-145 host computer and shall provide the capabilities required in support of the performance evaluation data base. The software shall execute in a shared environment under control of the S/370 operating system.

4.1 FUNCTIONAL REQUIREMENTS

To support the management of the performance data base, the file maintenance software shall:

- o Update the data base as a result of additional Input Processing Software
- o Provide capability for manual input to the data base for data collection/addition/correction
- o Provide capabilities required in performance of data base maintenance, access, and update functions
- o Provide security of data base contents.

The following paragraphs address the detailed requirements which must be satisfied.

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4.2 AUTOMATIC UPDATE OF DATA BASE

The output of Input Processing Software shall create the performance evaluation data base as an automatic function of its processing.

4.3 MANUAL INPUT TO THE DATA BASE

The performance evaluation data base shall contain non-instrumentation data relating to description and performance of solar heating and cooling systems. In addition, manual input for correction of data base contents shall be supported. Both terminal input and batch input techniques shall be provided.

The manual interface capability shall be used to generate initial data files within the data base and shall be used to enter non-instrumentation data, problem descriptions, problem solutions, site anomalies, and other texttype information pertinent to site performance evaluation.

During the manual input of data, the software shall perform editing on format of input to ensure that incorrect data is not entered into the data base. Messages shall be provided to indicate erroneous input (on display tube from terminal input and via printout for batch mode).

4.4 DATA BASE MAINTENANCE, ACCESS, AND UPDATE

The normal data base maintenance, access, and update capabilities shall be provided for support of the performance evaluation data base. The file maintenance software shall provide:

- o Predefined operations to be performed on the data elements when maintenance is being performed.
- o Interface between the data base processing language and user written routines for data editing. (No longer applicable)
- o Data field editing while performing file maintenance.
- o Indication of errors in data makeup for corrective action.
- o Statistics on system characteristics for use in improving performance.
- o Ability to access multiple files within the same processing sequence.
- o Capability for keyword/secondary indexing of data fields.
- o System recovery/restart.
- o Data migration (archiving) of data from the data base on selected basis.
- o Support of restructuring data files to allow for changes in either file size or content.
- o Data base utility functions for data conversion.

4.5 DATA BASE SECURITY

The file maintenance software shall provide security in access of the data within the data base. The data base security capabilities shall be utilized in either the terminal or batch mode of operation. Details of the security requirements are contained in the following paragraphs:

Terminal Access

Data base security within the terminal access mode shall consist of sign-on, password, and file classification security techniques.

At sign-on to the terminal, the user shall specify accounting information and name. This information shall be verified for correctness, and if incorrect, a message shall be displayed specifying that incorrect accounting information has been entered. A sign-off shall be required before the terminal will be reactivated within the system.

If a log-on is successful, a password shall be required before proceeding. Error messages shall be provided to the terminal during password editing.

Successful completion of password processing shall result in a user's being allowed to request that a data file be opened for access.

If a data file open request is entered, the software shall ensure that the user has the authority to access the data file being requested through file classification. The software shall allow the user access to: (1) read only, (2) write only, or (3) both based on the access table within the system. If the user does not have proper file classification code, he shall not be allowed to address the data file, and an error message shall be displayed.

Batch Access

Security within the batch mode of operation shall be similar to that described above for terminal access with the exception of "sign-on" security which does not apply to batch operations. For password and file classification protection, erroneous requests shall result in the batch job being terminated and error messages being printed for user action.

Access Authority

Authority to access the data base shall be controlled via formal procedures. Program Office approval shall be required prior to releasing password information and shall be required to add user's identification to the access list.

5. USER SUPPORT SOFTWARE REQUIREMENTS

The user support software executes in the S/370-145 host computer and provides those capabilities which are critical to the performance evaluation activity. Presentation of information in a form supporting evaluation and satisfying the needs of a diverse user community shall be the overriding objectives of this element of the software.

5.1 FUNCTIONAL REQUIREMENTS

The user support software shall utilize the contents of the performance evaluation base to provide the following:

- o Information retrieval capability for report generation (non scheduled)
- o Plot capability for support of analysis activities and inclusion in reports
- o Generation of daily, monthly, and annual reports (scheduled output)
- o Generation of magnetic tapes
- o Terminal/Batch capabilities

The detailed requirements in the above capabilities are described in subsequent paragraphs.

5.2 INFORMATION RETRIEVAL

The user support software shall provide the user with the capability to access the data base contents on a non-scheduled basis for generation of reports/plots to support his daily analytical activities. A conversational language shall be provided to allow the user to generate queries to satisfy his own unique requirements. The retrieval capability shall be supported in both terminal/batch modes of operation and shall provide the following:

- o Retrievals against single/multiple files.
- o Data qualification via user generated subroutines.
- o Terminal data entry/collection from desired files.
- o Batch processing of large data retrievals/updates.
- o Multiple answer files from one retrieval.
- o Versatile output formatting with headers, labels and boolean processing capability.
- o Library capability for temporarily storing queries for repetitive use.
- o Display statistical summaries of selected parameters.

5.3 PLOT CAPABILITY

The ability to provide the performance analyst with plots of instrumentation shall be an essential capability within the user support software. The software shall provide the ability to:

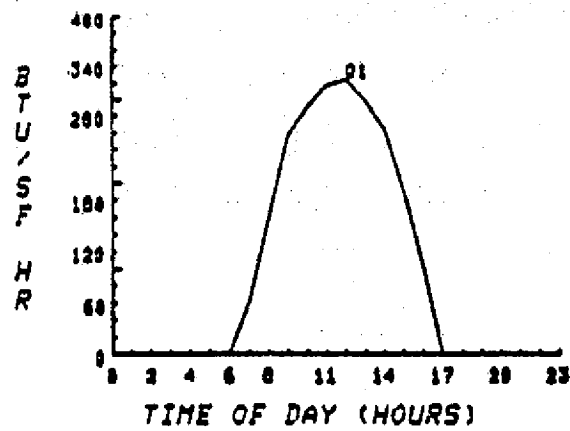
- o Plot selected parameters versus time
- o Plot parameter versus parameter over time interval
- o Plot multiple parameters against time
- o Provide multiple plots on the same CRT image

The Tektronix 4015/4631 terminal-hardcopy unit shall be supported by the software to provide both plots for analysis on the display and hardcopy of plots for inclusion in reports.

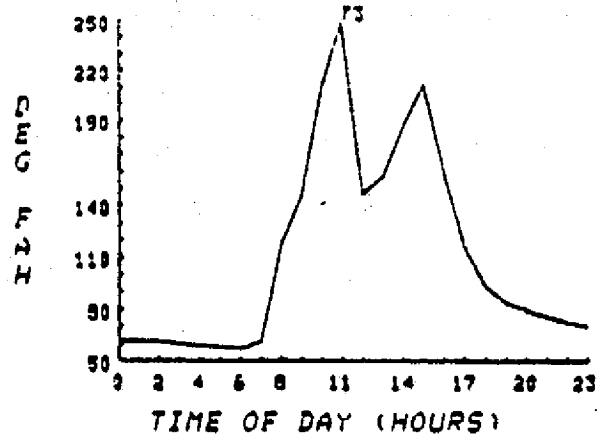
Input to the plot support software shall be a file created through use of the information retrieval capability. The ability to process multiple input files to produce multiple hardcopy reports shall be provided. Interactive capability with data base for plots will be provided.

Representative examples of plot requirements are shown in Figure 9.

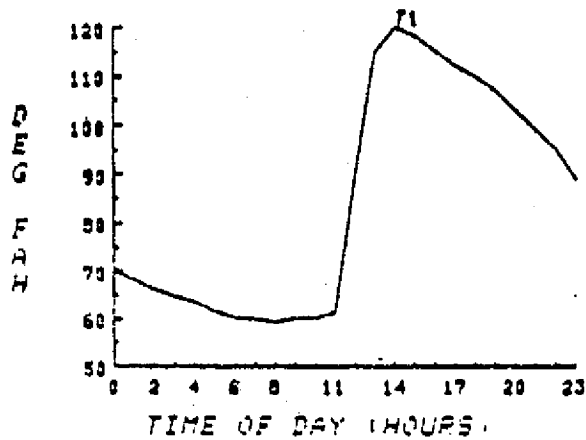
COLLECTOR INCIDENT SOLAR RADIATION



COLLECTOR SURFACE TEMPERATURE



HOT STORAGE TANK TEMPERATURE



OUTDOOR AMBIENT AIR TEMPERATURE

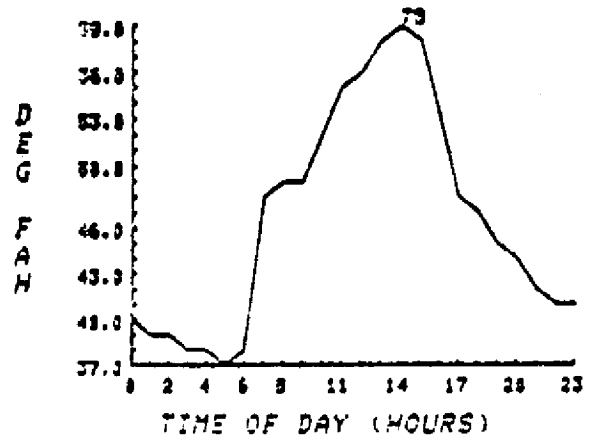


Figure 9. Terminal Graphs and Plots

5.4 GENERATION OF SCHEDULED REPORTS

The user support software shall provide the capability to access the data base on a planned basis for generation of scheduled output records. The software shall provide libraries of standard information retrieval queries which create the reports in the required formats. After completion of the daily data base update, the daily summary reports shall be generated and will present data summarized on an hourly basis. Monthly summary reports shall be generated and will present data summarized on a daily basis.

5.5 MAGNETIC TAPE GENERATION

The user support software shall provide the capability to generate magnetic tapes compatible with user (MSFC/ERDA/MSFC associate contractors) computer facilities. Magnetic tapes in either 9-track 1600/800 BPI or 7-track 800 BPI formats shall be generated. The information retrieval capability shall be utilized to access the data bank to create data files containing the required data in the correct format. User support software shall be provided to access the data files and write the data to the magnetic tape for delivery to users.

5.6 TERMINAL/BATCH CAPABILITIES

In support of users, the user support software shall provide access to performance evaluation data bank contents via both terminal and batch modes. The terminal supported shall be IBM 3277 units located with the IBM facility (local terminals). An interactive terminal capability shall be provided for access and display of data base contents. Displays shall be text or numerical information and shall be used for on-line performance evaluation activities. Hardcopy outputs and graphic displays cannot be generated on the interactive terminals but shall be provided via the batch mode (hardcopy) and plot capabilities (graphic on the Tektronix 4015/4631 display unit dedicated to support of performance analysts within the IBM facility).

The terminal processing software shall provide the user the capability to:

- o Generate and execute information retrieval queries
- o Execute predefined information retrieval queries
- o Submit batch jobs via remote job entry
- o Use a conversational language to define output formats
- o Perform maintenance on existing data files

The batch operating capability shall provide the capability to perform the following:

- o Generate and execute information retrieval queries
- o Execute predefined queries
- o Production of hardcopy reports

6. PERFORMANCE EVALUATION DATA BASE REQUIREMENTS

The performance evaluation data base shall be located on disk storage and magnetic tapes within the S/370-145 host computer and shall contain all data files required in support of performance evaluation activities. Management and access to data within the data base shall be via the data base management and user support software.

6.1 FUNCTIONAL REQUIREMENTS

The performance evaluation data base shall be organized to provide each major data bank user with his own data file yet provide the capability to correlate information among the files. The data contained within the data base shall include both automatically-entered and manually-entered data.

The data base shall provide files for the following:

- o Remote site description
- o Remote site operational data
- o System analysis simulation/weather data
- o System integration data
- o Subsystem evaluation
- o Configuration management
- o Software development
- o Raw data file

Each of the files shall have the following design requirements:

Fixed Data Elements - Data fields, which represent record keys, site/system characteristics, site/system identification, geographical, and past climatological information, shall remain fixed within data set records for life of the Solar Heating and Cooling Development contract. These fields shall be protected from arbitrary access and inadvertent destruction to avoid propagation of error throughout the remainder of the data base.

Periodic Data Elements - Data values, which represent solar system and subsystem integration and testing data, and data collected from operational sites will recur on a fixed periodic basis as input to the data base. The periodic interval shall be one of the following: five minute sampling interval of raw data readings, summarization intervals such as hourly, daily, etc., and pre-defined intervals in accordance with the schedule for system and subsystem testing. Periodic data shall be pre-processed (converted to engineering units, limit checked, scaled, etc.) prior to being included in the data base.

Variable Information - Variable data fields shall contain text and commentary information and also as pointers to data items in

off-line storage. Of particular importance will be the maintenance of failure history information for each remote site.

Grouped Data Elements - To simplify data manipulation and retrieval, continuous fields of related data shall be grouped and secondarily named as one field when appropriate. For example, the latitude, longitude, and elevation of a site shall be grouped under one name, 'location', to facilitate data operations.

Data Value Modes - Both alphameric and numeric data value shall be stored in the data base. Record elements which are defined as alphanumeric mode shall require EBCDIC characters to be stored as bytes. These fields shall not require mathematical processing. Record elements (fields or groups) containing numeric values shall require processing using mathematical operators.

Data Set Record Sizes - Record sizes will vary between the data base files. It will depend upon the number and length of the data elements within each record and the Operating System access methods used to read/write the files.

Catalogued Procedures - To ease the requirement on the user to supply all the necessary job control statements and language whenever a system component is used, catalogued procedures shall be prepared. These procedures are sets of previously written job control statements which will require prior storage into the System Library, uniquely named, and automatically retrieved during execution. Examples of required procedures are those to generate routine and fixed format reports, such as daily, weekly, monthly and quarterly analysis and evaluation reports.

Assembly and Higher Level Language Routines Support - The data base user shall be provided the flexibility to process his data directly from the data base and optionally update the data base from the calculated results. The use of a conversational operating system allows for the interactive processing of data by the use of application programs (higher level language routines) developed by the user.

Secondary Indexing Capability - Secondary indexing shall provide the user with the capability to index files in the data base by the contents of a field or fields other than the record key identification (e.g., date/system/site ID). The primary purpose of this capability is to provide a faster response time for qualifying records during retrievals. Representative fields which are required to be indexed due to their frequency of use are:

- o Subsystem (collector, storage, etc.) manufacturer's identification
- o Subsystem type identification
- o Subsystem material type identification
- o Subsystem cost category (economical, marginal, uneconomical)
- o Subsystem efficiency category (very high, high, average, low, very low)

IBM Standard 370 Software - The System/370 Partition Data Set (PDA) access method shall be utilized to support software development and configuration management. The Partition Access Method allows rapid access to software modules and configuration management reports by "name" alone. Each name and its associated data is a member of a PDS.

Interfile Output - Interfile output (IFO) is the capability to combine data from several related files (data sets) during output processing. This capability shall be required when the user requires information from several files to satisfy a complex information retrieval query.

6.2 REMOTE SITE DESCRIPTION

The remote site description file shall contain physical characteristics of the remote site, description of the solar heating and cooling system, auxiliary power costs, and other characteristics needed to evaluate performance of the system. Since no instrumentation data is included within this file, manual input shall be required to generate, update, and maintain the file. Correlation information shall also be included to allow interfile access to satisfy complex queries requiring information from several files. Pointers shall also be included for correlation to off-line documents pertinent to each site.

The remote site description file shall reside on the disc and be immediately available throughout the life of a remote site.

6.3 REMOTE SITE OPERATIONAL DATA FILE

The remote site operational data file shall contain the daily processed instrumentation data from each remote site. Because of the volume of data, only one month's input shall be maintained on disk for immediate access. Data more than one month old shall be maintained on magnetic tape.

This file shall be organized by remote site ID and operational data shall be in chronological order over the month interval. In addition to the detailed instrumentation data, the file shall contain hourly summaries (over previous month interval), daily summaries (over life of remote site), performance evaluation parameters computer during the input processing activities, and correlation information to support interfile queries. This file shall also contain correlation information to files which contain manual input such as non-instrumented data, site anomalies, failures, etc. The file shall be automatically updated on a daily basis.

Because this file shall contain the data of most interest to the performance analyst, the design shall optimize data organization to minimize retrieval/ access times in generation of reports/plots.

6.4 SYSTEMS ANALYSIS SIMULATION/WEATHER DATA

In the prediction of system performance at a remote site, systems analysis simulations will be performed. The results of the simulations performed for reference with operational performance shall be maintained in this data file. Weather data (US Weather Service Data) used during development of reference predictions shall reside on magnetic tapes; however, the data file shall contain reference to weather data used. Actual weather data recorded at the remote site will also be available on magnetic tape with format suitable for simulation input. This tape will contain as a minimum hourly values for incident solar radiation and ambient dry bulb temperature. If available, wind speed, diffuse radiation and relative humidity will also be included.

The results of remote site predicted performance simulations shall be provided in summary form for correlation with data reports generated from the remote site description and remote site operational data files. The results of reference simulations shall be organized by site ID and automatically entered into the data file by the simulation software.

6.5 SYSTEM INTEGRATION DATA

Each solar heating and cooling system installed in remote sites shall be assigned a unique identification for evaluation purposes. The file shall contain the identification of subsystems comprising the system, characteristics of the system as determined during testing or from vendor provided information and pertinent test data.

This data file shall be manually updated and shall reside on disk for lifetime of the solar heating and cooling system.

6.6 SUBSYSTEM EVALUATION DATA

Each subsystem provided to IBM for use in systems integration shall be included within this data file. Characteristics of the subsystem (both vendor data and MSFC test results) shall be included within this data file. The file shall be organized according to subsystem type (collectors, storage, hot water, cooling, heating, etc.).

The data file shall reside on disk and shall be manually maintained. The file entry for each subsystem shall remain active throughout the utilization of the subsystem.

6.7 CONFIGURATION MANAGEMENT

The configuration management data file shall provide the capability to maintain historical data pertaining to change activity. Both hardware and software changes shall be maintained on disk within the host computer. Upon release of first articles for use, an entry within the configuration management data file shall be established. All changes made to these baselines shall be entered into the file along with associated documentation.

6.8 SOFTWARE DEVELOPMENT DATA

The software development data file shall contain the library of baselined software deliveries. Both source and load modules shall be included and shall be identified by 'name' within the file. Security shall be provided to ensure controlled access to the file.

6.9 RAW DATA FILE

The Raw Data File shall reside on magnetic tape and disk storage within the IBM facility and shall contain a history of all raw data received from each remote site. Raw data shall be organized according to day of receipt and shall be sequenced in the order in which remote site data was collected. Data less than one month old shall be maintained on disk, then on a monthly basis dumped to magnetic tape.

7. SOFTWARE VERIFICATION REQUIREMENTS

Verification of the CDPS software shall be performed prior to the overall CDPS becoming operational. This verification shall be performed while utilizing the CDPS hardware and shall consist of three phases:

Development Verification - Analysis and testing performed to ensure that elements of the CDPS software satisfy requirements.

Qualification Verification - Testing to ensure that the software system satisfies overall design requirements.

Acceptance Verification - Testing to ensure that the software system satisfies normal operational requirements.

During qualification and acceptance verification, test procedures shall be prepared and followed. Test results shall also be documented.

Details of the verification plan and approach are contained in the "CDPS Verification Plan" and other CDPS documentation.

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APPENDIX A
PROGRAMMING
STANDARDS

1. INTRODUCTION

During the development, documentation, and maintenance activities associated with providing an operational CDPS capability throughout the lifetime of the demonstration program, a set of programming standards shall be utilized. The use of these standards results in an organized and systematic approach which provides reliable software which is easily understood and maintained.

1.1 SOFTWARE IMPLEMENTATION STANDARDS

The standards/conventions/procedures established for the software implementation phase are to provide continuity among the many programmers assigned. The implementation phase is usually the most difficult to control because of the individuality involved. A significant objective of standards is to establish a more structured approach to the coding process and to obtain program listings more easily understood and transferable.

Standards to be utilized during software development are discussed in more detail in the subsequent paragraphs.

1.1.1 Structured Coding Technique

In concept, structured coding is an extension of the approach utilized in hardware design and development, of constructing complex circuits from elementary AND, OR, and NOT gates. The software analogies to the hardware components are:

- o Sequence of two operations.
- o Conditional branch to one of two operations and return.

Programs written using structured code can be literally read from top to bottom typographically; there is never in line branching as is typical in trying to read code which contains "GO TO" statements.

An important task in assuring that a program meets its design requirements is the detailed audit procedure. Since this audit is best performed by someone not intimately in the program development, readability of the code is of prime importance. One of the advantages of the structured code technique is that it provides a basis for systematic reading of the program. The reading sequence within each segment is strictly from top to bottom. As a result, audit procedures are made more systematic and result in higher software reliability.

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1.1.2 Program Support Library

The programming support library (PSL) is a set of clerical and computer procedures designed for use in a software development environment, plus the clerical support needed to make it work. The principal objective of the library is to provide up-to-date representations of the programs and test data in both computer and human readable forms. The design of the procedures permits most of the clerical and recordkeeping operations associated with programming to be isolated from the programmer.

The principal advantages gained from use of the program library on software development are:

- o Frees the programmer from clerical duties.
- o Centralizes the software system development activity.
- o Provides discipline to system development process.
- o Increases management visibility and control over software development.

1.1.3 Top-Down Development

The top-down development technique is the application of the natural system design approach. This technique requires the software control architecture and interfaces be established and developed first and succeeding levels of detailed logic implemented in a downward fashion. Top-down development provides an ordering which allows for continual software integration of system components and provides for well-defined interfaces at each level.

In top-down development, the system is organized into a tree structure of segments. The top segment contains the highest level of control logic and decisions within the program and either passes control to lower level segments, or identifies lower level segments for inline inclusion. The process continues for as many levels as required until all functions within a system are defined in executable code.

Many system interfaces may occur either through data base definition or calling sequence parameters. The top-down approach requires the data base definition statements be coded and actual data records be generated before exercising any segment which references them.

The top-down approach provides the capability of evolving the product in a manner which maintains the characteristic of being always operable, modular, and always available for the successive levels of testing that accompany the corresponding levels of implementation. The quality of a system produced using this approach is increased, as reflected in fewer errors in the module integration process.

Inconsistencies are eliminated, and lower level segments can be generated by referencing implemented code.

1.1.4 Coding Standards

A critical item in the production of software which is easily understood, transferable, and maintainable is the establishment of standards to be utilized during the coding process. The output of the coding process, the program listing, is the most highly utilized portion of the documentation package and must be controlled through the application of standards. High order languages, which support the structured programming concept, shall be used.

1.2 SOFTWARE TESTING STANDARDS

The software shall be tested in an atmosphere which emphasizes the need for planning of testing. Because of the emphasis of high quality in the operational use of software, a highly structured approach must be followed to ensure that, in addition to satisfying user requirements, the operational system satisfies the objectives of maintainability and transferrability.

1.2.1 Top-Down Testing

Top-down testing concentrates all testing activities on verifying functional capabilities of the software in the system environment. The benefits are increased system reliability, reduced testing cost, and a more visible testing process.

Using the top-down approach to software system development and a programming support library, all tests shall be performed in the system environment. The top-down approach ensures that all interfaces needed to execute are available when testing begins. Hence, program interface assumptions are never made and all testing verifies the real interfaces. Testing new programs or program changes in a temporary mode, without permanently modifying the systems, is easily done. When the program is tested, it shall be incorporated into the master system via the system build after receiving IBM management/NASA review for change control. Performing all tests against the master system accomplishes integration testing continuously as the functional capabilities are verified.

1.3 SOFTWARE DOCUMENTATION STANDARDS

The software documentation shall be generated in a continuing fashion throughout the software development phase. As was discussed, the programming support library will provide the central facility for generation of documentation. The primary documentation output shall consist of:

- o Software Requirements Document
- o Software Design Document
- o Users Manual

1.3.1 Structured Documentation

Documentation consists of the products of the definition and design activity. Implementation, verification, validation, and delivery will only modify design documentation. Employing top-down design will require that documentation be developed in a hierarchical, tree-like fashion. Top-level descriptions will reflect functional software operations. These high level descriptions will, in turn, be explained and/or expanded by lower level descriptions, and the process continued to the lowest module level. This produces documents that can be read and understood at any level. In addition, physically seaprate documentation required by volume can be done without impacting readability.

Readability shall be provided by describing software operation in the following manner:

- o Visual Table of Contents
- o Overview diagrams
- o Detail diagrams
- o Supporting text and annotated data

Functional documentation proceeds from a top level Visual Table of Contents diagram down to a basic module diagram of input, Processing, Output, functional chart. For each task to be performed, a module diagram shall be developed.

1.3.2 Flow Chart Standards

Although use of high-level language for software development reduces the usefulness of flow charts, flow charts will be required for deliverable documentation. The flow charts will depict how the software performs in the satisfaction of requirements.

To provide ease of correspondence between program listings and flow charts, the picture-on-a-page technique applied during coding will be applied to the generation of flow charts. Through this technique, a flow chart will exist for each routine of the software, and both the flow charts and listing will provide direct correspondence.

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APPENDIX B
CDPS OPERATIONS APPROACH

1. INTRODUCTION

The CDPS must satisfy the processing and user support requirements resulting from daily data collection from all remote sites. To provide data to analysts by the beginning of first shift each day, an operations procedure has been established and is discussed in the following paragraphs.

1.1 DATA COLLECTION

SDAS data collection will occur during the evening hours (beginning at 2000). The collecting will continue until approximately 2330 (60 sites require approximately 3.5 hours) and upon completion, will be transferred via data link to the S/370-145 (requires 30 seconds). Computer operator intervention will be performed at the start of data collection time period to initiate the System 7 software. During the data collection time period, the communication interface computer console will be monitored for indications of telecommunications progress in contacting and receiving data from the SDAS equipment. In the event of communications difficulties, effort will be undertaken to resolve the problem during the hours dedicated to data collection. The communication operations personnel will be guided in the problem resolution by directions from the S/7 software analyst. The operator will, as required, interface with the MSFC Telecommunications Systems Status Center (TSSC) for resolution of communications difficulties.

1.2 DATA PROCESSING

Data processing on the host computer will occur between the hours of midnight and 0700 each day in order to provide error reports and summary reports and performance reports for SIMS analysts at the beginning of first shift (0800). The Input Processing portion of the CDPS software system will be executed, upon completion of data communication and retrieval by the Communication Interface computer, and will process the forwarded data from the System/7. All processed data containing no errors will be converted into engineering units, performance calculations performed, and data made ready for insertion into the performance evaluation data base. Errors encountered during processing will be flagged such that erroneous data will not be entered into the data base, and error messages/reports will be provided for analysts.

1.3 DATA BASE PROCESSING

Upon completion of the Input Processing phase, the Data Base/User Support software will be executed in a batch environment under control of computer operations personnel. This processing will be accomplished in a manner to satisfy data availability requirements and output distribution.

To ensure timely completion, a high priority will be assigned to the processing of input data and will be monitored by operations personnel. If conflicts occur, the processing will be assigned the highest priority and will override any other processing.

Archiving of data will be provided through the use of software within the host computer. Raw data, processed data, and performance reports will be maintained within the computing facility and will be distributed as required for analysis/storage.

1.4 USER SUPPORT

User support will require that the data base management software allow ready access to the data base contents via local terminals and support batch job access to data for special analysis activities. When the IBM performance analyst requires a terminal capability to access the performance evaluation data base he/she will utilize the operating systems conversational capabilities. This will free computer resources (core memory) for use by other processing requirements instead of tying those resources up when terminal activity is not required.

1.5 DATA BASE MAINTENANCE

In addition to the daily scheduled updating of the Performance Evaluation Data Base with input from the Input Processing Software there will be the capability to perform selected maintenance on an as required basis.

1.5.1 Error Correction

Error conditions on data fields within the data bank corrected during first shift will be entered into the data base via local terminals (for small data volume) or via batch job submission. Upon completion of error correction, the performance evaluation data within the data base will be formatted and written to magnetic tape for transfer to the MSFC Solar Energy Data Base.

1.5.2 Non-Instrumentation Data Handling

Data elements to be added to the data base which are not gathered by the SDAS and processed in the CDPS, such as site location, site equipment availability, weather data, etc., will be entered into the data base via terminal or batch mode. This will allow for text type data to become part of the data base and available for reporting purposes.

SECTION B

CENTRAL DATA PROCESSING SYSTEM HARDWARE PERFORMANCE SPECIFICATION

DWG NO.
7933190

REVISIONS

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1.0 INTRODUCTION

The Central Data Processing System (CDPS), through its hardware and software, shall provide the data collection, data processing, data archiving, and data distribution functions associated with performance evaluation of Solar Heating and Cooling Systems. The hardware, included within the CDPS, shall reside at IBM's FSD facility at Huntsville, Alabama and shall consist of two elements - a communications interface configuration and a host computer configuration. The performance specifications associated with this hardware, in support of the Systems Integration of Marketable Subsystems (SIMS) contract, are discussed in the following sections of this performance specification document.

2.0 TYPE OF HARDWARE

The hardware, to be used within the CDPS, shall consist of commercially available hardware.

3.0 COMMUNICATION INTERFACE CONFIGURATION

The Communication Interface Configuration shall provide:

- (1) Hardware required to interface with the Site Data Acquisition Subsystem (SDAS) via telephone lines for data collection.
- (2) The computational capability to control automatic call-up of each remote site on a daily basis, to control communication protocol with the SDAS, perform error checks on incorrect data, format data for subsequent processing on the host computer configuration, and store data for transmission to the host.
- (3) Input/output capability for operator intervention in event of errors and for logging of communications activity and error conditions.
- (4) A multiprogram environment for software execution.
- (5) Hardware for transmission of recorded data to the host computer configuration.
- (6) Mass storage for temporary storage of recorded data.
- (7) Operational environment which requires minimum operator support during the data collection activities.

The performance specifications relative to the above capabilities are discussed in the following paragraphs:

3.1 SDAS INTERFACE

The SDAS interface hardware shall provide the capability to: (1) accept automatic dial signals from the communication interface computer, (2) perform the automatic dial function, (3) provide interface to a modem compatible with the modem contained within the SDAS, (4) receive data from the SDAS via the telephone lines, and (5) interface the data to the communication interface computer. A feedback mechanism shall exist in all hardware for signalling correct/incorrect operation.

The hardware associated with the above functions shall consist of:

- (1) Teleprocessing multiplexer (TPMM) for computer controlled operations.
- (2) Auto-call unit to support automatic dialup feature.
- (3) Modem for telephone line interface.

The specifications of these hardware elements are discussed below.

3.1.1 Teleprocessing Multiplexer Performance Specifications

The Teleprocessing Multiplexer shall provide the following capabilities in support of computer functions:

- (1) Software selection of operation (asynchronous mode for SIMS).
- (2) Internal mode of clocking to support asynchronous transmission.
- (3) Receive/transmit at 1200 Baud Rate on telephone.
- (4) Automatic call of Remote Sites under software control.
- (5) Interrupt communication processor on each byte of data transmitted/received (serial to parallel and parallel to serial conversions).
- (6) Status information regarding communications status.

3.1.2 Automatic Call Unit Specifications

The Automatic Call Unit (ACU) shall accept the above signals from the TPMM hardware under control of the computer software and perform the Automatic Dial Functions. The Automatic Call Unit shall provide the TPMM with control information regarding the dial function.

The sequence of operations between the TPMM and the Automatic Call Unit shall consist of:

- (1) Call Request (CRQ) line - activated by the computer to indicate that a call is to be placed.
- (2) Present Next Digit (PND) - activated by the ACU to signal the computer that the ACU is ready to accept the next digit for dialing.
- (3) Digit leads (NB1, NB2, NB4, NB8) - activated corresponding to the digit to be dialed.
- (4) Digit Present (DPR) lead - activated by the computer to signal that a digit has been placed on the Digit leads (NB1-NB8).
- (5) Data Line Occupied (DLO) lead - indicates to the computer whether the line is busy or not.
- (6) Abandon Call and Retry (ACR) lead - indicates to the computer that the called party does not answer or that, for some reason or other, the call is not completed.
- (7) Data Set Status (DSS) lead - activated by the ACU when the connection has been established.

The ACU within the CDPS shall be Bell 801 or equivalent.

3.1.3 Modem Specifications

The modem within the CDPS shall be the Bell 202C or equivalent and shall be compatible with the modem within the SDAS.

The communications interface computer shall provide the control, interface, and application programs necessary for complete control of the Communications Interface. The computer shall be interrupt driven, provide cycle capture of data to memory, and have growth potential in both storage and processor CPU cycles.

3.2.1 Processor CPU Specifications

The CPU shall provide support for priority level processing through the use of an interrupt handling system within the hardware. When an interrupt occurs, the current status of the processor shall be automatically saved within specific save areas for continuation of processing after interrupt servicing. Four levels of priority processing shall be provided with the capability to define 16 sublevels of priority within each primary level.

The instruction set provided by the CPU shall include the following classes of instructions:

- (1) Load and Store
- (2) Arithmetic
- (3) Logical
- (4) Shift
- (5) Branch
- (6) Register-to-Register
- (7) Input/Output

The CPU shall be capable of handling multiple input lines simultaneously.

The CPU shall perform parity checks on all data stored or retrieved from the Memory Unit of the computer. An odd-parity technique shall be provided.

The CPU shall provide capability for addressing storage and for maintaining computer status within the computer.

The following registers and indicators shall be provided:

- (1) Storage Address Register
- (2) Instruction Address Register
- (3) Index Registers
- (4) Accumulation Registers

- (5) Interrupt Registers
- (6) Carry Indicator
- (7) Overflow Indicator
- (8) Result-Zero Indicator
- (9) Result-Even Indicator
- (10) Result-Positive Indicator
- (11) Result-Negative Indicator
- (12) Interval Timer Registers

3.2.2 Memory

The memory of the computer shall be sufficient to support the anticipated needs of the software (approximately 24K 16-bit words) and shall provide the capability for expansion through field modification to the baseline system. Maximum required memory shall be 65K 16-bit words.

3.3 INPUT/OUTPUT SPECIFICATIONS

A complement of peripheral I/O devices shall provide support to the software executing in the processor to satisfy the operational requirements of the CDPS.

3.3.1 Operator Console

The operator console shall provide hard copy for information inquiries, status messages, memory dumps, and control and maintenance of the Communication Interface Software.

3.3.2 Direct Access Storage

A direct access storage device shall provide on-line storage for the Communications Interface Software and provide temporary storage for incoming input data. The direct access disk shall provide the capability to store information from 60 sites.

3.3.3 Additional Devices

The Communication Interface Processor shall have adequate growth capability and flexibility in terms of new I/O modules/devices. This growth shall be supported by the initial computer architecture and shall not require any significant reprogramming or hardware design effort.

3.4 HOST COMMUNICATIONS

An interface or data link from the Communication Interface Processor to the host computer shall be provided. The communications interface shall not

require constant host communication and shall support a stand-alone environment. The host communication link shall be a coaxial cable, and the distance supported shall be less than one mile.

3.5 OPERATIONS

After manual initiation, the communication interface configuration shall be capable of unattended operation during daily data collection from remote sites. In the event of errors which cannot be circumvented under automatic control, operator intervention shall be required.

4.0 HOST COMPUTER PERFORMANCE SPECIFICATIONS

The host computer shall provide the capabilities, through its peripheral devices and processing capabilities, to create, support and maintain the SIMS performance evaluation data base. The host computer shall receive remote site data from the communication interface computer over the Host/Communications Interface data link and accept manual inputs via cards or terminals for non-instrumentation data. The following sections specify the functional performance requirements of these elements.

4.1 MAIN MEMORY

Main memory shall provide the host computer with fast access, directly addressable storage of data. Main memory shall be of sufficient size to allow both SIMS data and programs to be loaded and processed. Main memory shall also have growth capability. The maximum storage requirements is estimated to be 256K bytes.

4.2 CENTRAL PROCESSING UNIT

The CPU shall be the controlling element for the host computer and shall provide facilities for:

- o Addressing main storage
- o Fetching and storage of data
- o Executing instructions
- o Initiating communications between main storage and I/O devices

The CPU shall support both fixed and floating point arithmetic operations as well as logical operations and shall be sufficient speed to support the SIMS data processing requirements.

4.3 INTERRUPTS

The host computer shall have an interrupt system to allow efficient use of I/O devices and for dynamic and fast response to peripheral equipment requirements. The interrupt system shall be used in a manner that results in a multi-program environment for the host computer.

4.4 INPUT/OUTPUT

The host computer shall have an input/output system that will adequately handle SIMS data transfers between main storage and the I/O devices. The input/output system shall be flexible and allow for additional devices to be added with minimal system impact.

4.4.1 I/O Channels

Channels are the direct controllers of I/O devices and control units. The host computer shall provide channels with the ability to read, write, and compute and relieve the CPU of the task of directly communicating with the I/O devices.

4.4.2 Direct Access Storage

The host computer shall have direct access storage available to provide auxiliary storage for the performance evaluation data base and off-line storage for program storage. Direct access space required for SIMS is estimated to be 200 million bytes.

4.4.3 Display Terminal

The host computer shall provide high speed, visual, interactive communications between the host computer and the user via display. The terminals shall provide the SIMS user with the means for entry and change of information in the host computer. The interactive mode shall be provided via IBM terminals. Graphics capability shall be provided via a Tektronix 4015/4631 Display Unit or equivalent.

4.4.4 Magnetic Tape

The host computer configuration shall support the production and delivery of magnetic tapes containing performance evaluation data. These tape units shall support 9-track 1600/800 BPI density and 7-track 800 BPI density.

4.4.5 Printer

The host computer shall provide high-speed printers (1100 lines per minute) for creation of reports to be delivered to users of performance evaluation data.

4.4.6 Card Reader/Punch

The host computer shall provide a card reader/punch for program and data input to the system.

4.4.7 Communications Interface

A communication data link shall be provided from the host computer to the communications interface configuration for high-speed transfer of data collected and buffered by the communications interface (see Paragraph 3.4).

4.5 OPERATIONS

The host computer shall be shared with other users. To insure that SIMS data processing is processed within specific time constraints, a high priority level will be assigned.

Prepared for the
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SPACE FLIGHT CENTER
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SECTION C

CENTRAL DATA PROCESSING SYSTEM SOFTWARE VERIFICATION PLAN

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1.0 INTRODUCTION

The Central Data Processing System (CDPS), which is comprised of both hardware and software, provides the essential capabilities of data collection, data processing and storage, and data user support for the SIMS Program. Because of its criticality in Solar Heating and Cooling System performance evaluation, the system must be verified prior to becoming an operational element of the program.

The objectives of the CDPS verification activity are to ensure that each element of the system, as well as the overall system, satisfies or exceeds the requirements established in the CDPS Performance Specification Documentation. The verification activity, therefore, requires a systematic approach to analysis and testing and sufficient documentation to provide traceability of test results. The approach, however, must ensure maximum confidence in system operation with the minimum expenditure of resources.

Within this document, all descriptions of and references to the CDPS hardware configuration are only to facilitate explanation of the software requirements and not to control the configuration of the hardware. The CDPS hardware is controlled by IBM and is used for support of multiple contract programs. To support this varying utilization environment, IBM must maintain the flexibility to modify the configuration as required. Because of this flexibility requirement, the CDPS hardware configuration may vary during the performance of the SIMS contract, but the capability to satisfy all SIMS processing requirements contained within the CDPS Hardware Performance Specification will be maintained.

1.1 PURPOSE

The purpose of this CDPS Verification Plan is to define the approach to be utilized in verification of the CDPS and to delineate the schedules to be followed in providing a verified CDPS.

1.2 SCOPE

This verification plan addresses the verification activities required of the CDPS. In addition, configuration control techniques are defined to provide management and NASA visibility into the verification activities.

1.3 APPLICABLE DOCUMENTS

The following documents are required in support of CDPS verification:

- (1) CDPS Hardware Performance Specification Document
- (2) System/7 Functional Characteristics
- (3) Site Data Acquisition Subsystem Performance Specification
- (4) Guide to S/370-145
- (5) System/370-145 Functional Characteristics
- (6) NMCS Information Processing System Manuals
- (7) S/7 Teleprocessing Description
- (8) CDPS Software Performance Specification
- (9) Programming Guide for System/7 Teleprocessing Feature (GC34-1549)
- (10) PL/1 Programmers Guide
- (11) IBM FSD Software Standards Document

2.0 CDPS DESCRIPTION

Within the overall Solar Heating and Cooling Demonstration Program, the CDPS performs the following functions:

Data Collection - The CDPS daily collects instrumentation data from all remote sites via standard voice-grade 1200 Baud telephone lines. In addition, non-instrumentation data available from MSFC, ERDA, HUD, etc., which is needed in performing overall system evaluation, is collected via manual means.

Data Processing - The CDPS accepts raw data, as collected by the data collection function, and performs the data processing functions required to transform the raw data into processed information for use in system evaluation/analysis activities. The CDPS also provides the resources to maintain a performance evaluation data base, containing both raw data and processed information, for use in support of performance analysts.

Data Archiving - To provide capability for detailed analyses of system performance and to maintain data for historical purposes, the CDPS provides the capabilities to archive data collected and processed. Both raw data and processed data is retained on magnetic tape, and formal reports are archived in a library.

Data Distribution - In addition to collection, processing, and archiving of data, the CDPS provides the essential function of distributing the data to the appropriate organizations. Distribution is in the form of printed reports, data plots, and magnetic tapes.

3.0 VERIFICATION APPROACH

The verification of the CDPS will consist of a systematic testing/analysis approach which will ensure that system specifications/requirements are achieved or exceeded. Test procedures will be generated and followed during testing of each CDPS component and test results will be documented in a qualification report for review by management and MSFC. Verification cross-reference matrices will be used to ensure that all CDPS requirements/specifications are addressed during verification.

Three phases of verification will be performed on the CDPS as defined in the following paragraphs:

DEVELOPMENT - Analysis and testing of design approaches to ensure that approach selection will meet system specifications.

QUALIFICATION - Analysis and testing of CDPS to design limits. Performed prior to entry to acceptance testing of the system.

ACCEPTANCE - Testing of the operational CDPS as a system to ensure that overall system satisfies system performance specifications.

The development and verification activities associated with the CDPS are shown in Figure I.

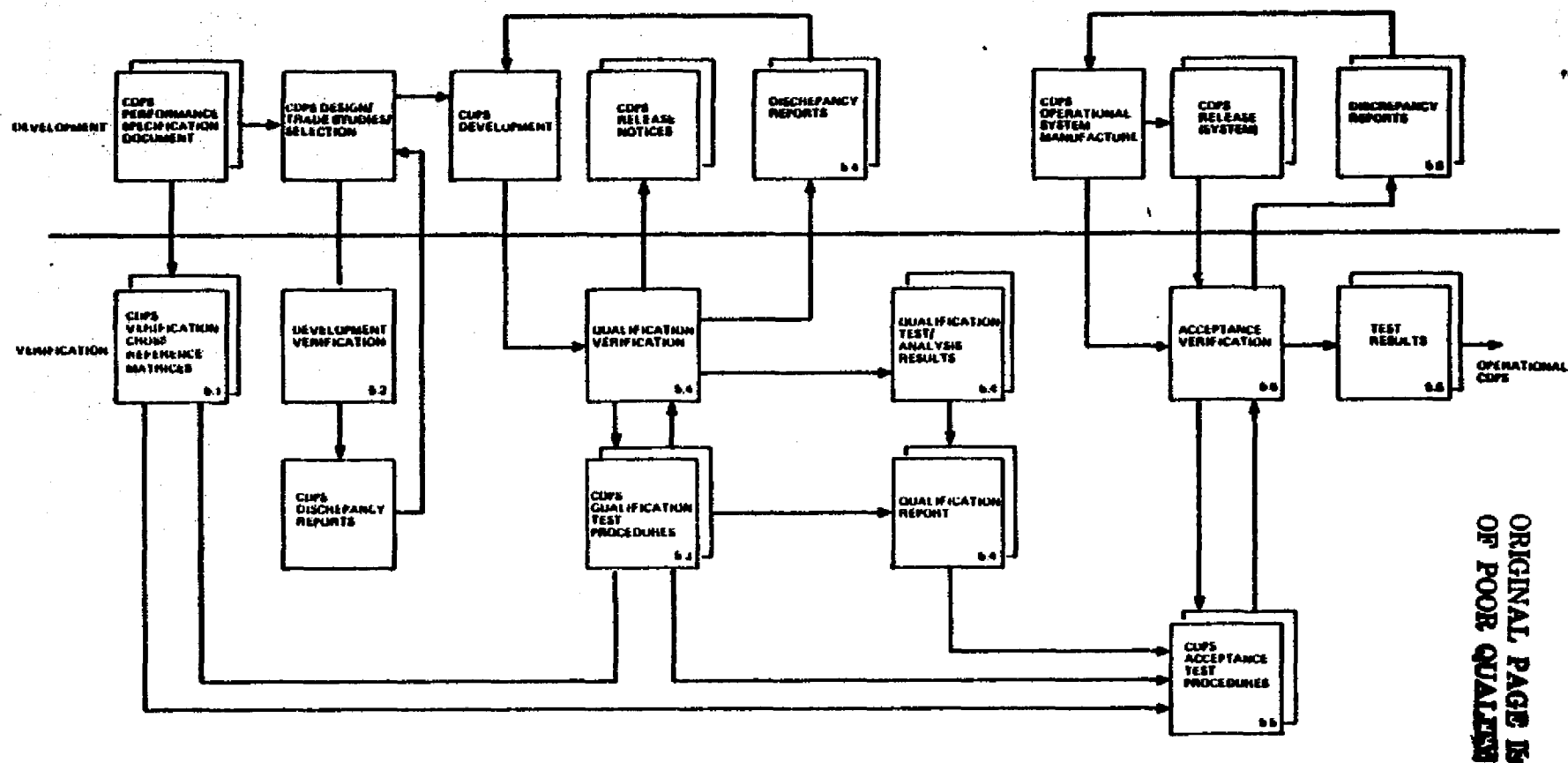


Figure 1. CDPS Verification Approach

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4.0 DEVELOPMENT/VERIFICATION SCHEDULES

The CDPS is scheduled to be fully operational by 9/1/76. To achieve this program milestone, development and verification schedules have been defined and are shown in Figure 2. Discussion of the schedules is given in the following paragraphs.

4.1 DEVELOPMENT SCHEDULE

Development activities have been scheduled to provide software elements which have undergone preliminary development verification activities by 7/1/76.

4.2 VERIFICATION SCHEDULE

Development verification will be accomplished during June on individual software/system elements and during July on system integration activities for the overall CDPS.

Qualification verification will commence on 8/1/76 and will extend until approximately 8/25/76. During this period detailed verification will be performed to test the system to design limits.

Acceptance verification will commence on 8/25/76 and extend to 9/1/76. Upon completion of acceptance verification, the CDPS will be considered operational to support the overall program.

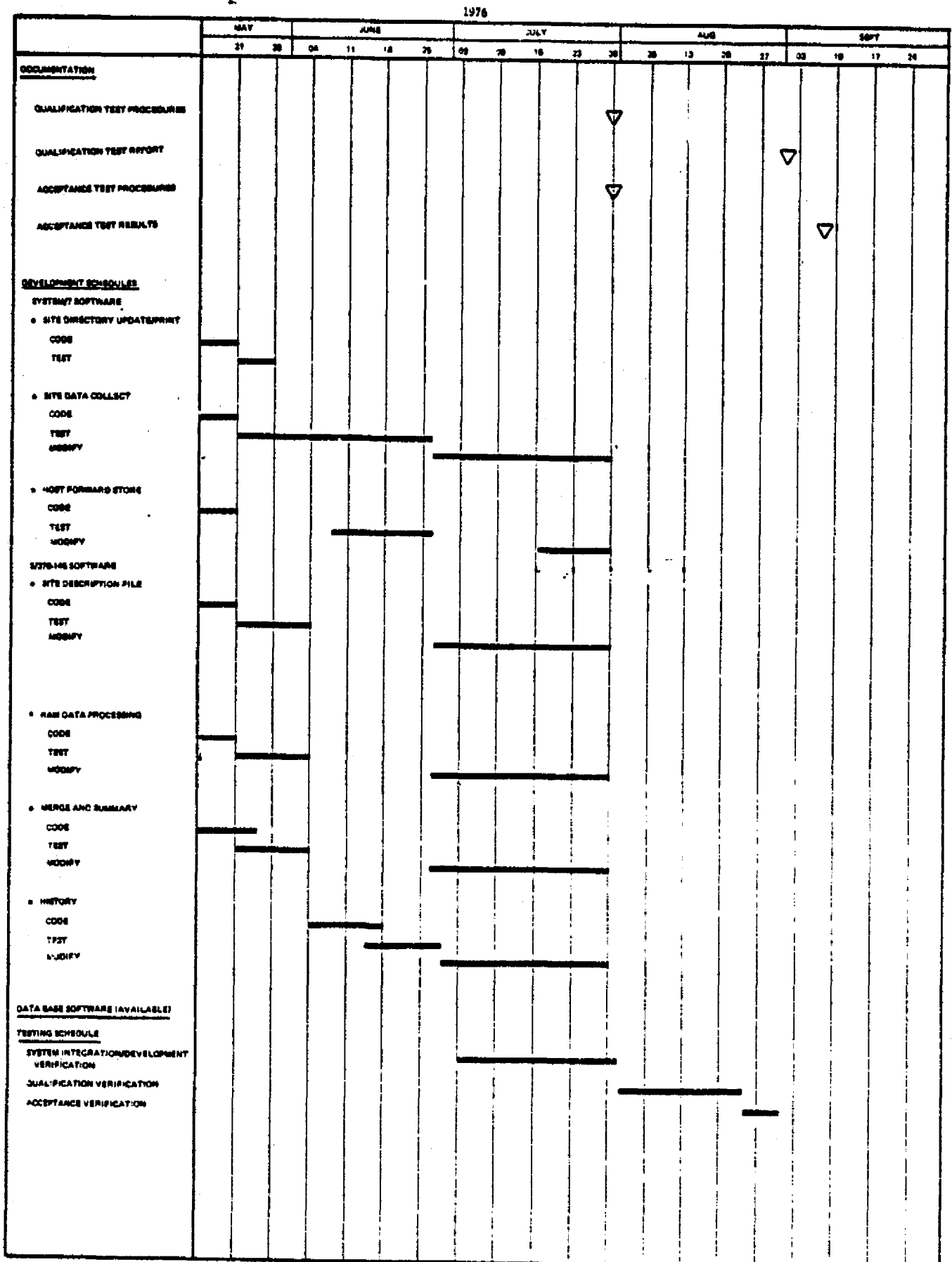


Figure 2. Development Schedule

5.0 TESTING CONFIGURATION/UTILIZATION

The testing configuration for use in verification of the CDPS capabilities relating to data collection/data processing/data base update/user support is shown in Figure 3. As can be seen in the figure, the configuration consists of the following elements:

- o System/7 Test Software
- o Controlled Signal Generation Equipment
- o Site Data Acquisition System (SDAS)
- o Telephone Line Interface
- o Communication Interface Configurations
- o Host Computer Configuration
- o Performance Evaluation Data Base

A description of each of these elements and the rationale for their use during verification activities is discussed in subsequent paragraphs.

5.1 SYSTEM/7 TEST SOFTWARE

To provide the CDPS verification activity with reasonable SDAS control and sensor data, a System/7 test software package will be required. This software will allow an SDAS and sensor configuration to be simulated for the purpose of generating CDPS test data. These simulator signals will be recorded for reference with CDPS output. The use of the System/7 software for SDAS and sensor simulation results in a significant reduction in CDPS verification complexity and provides flexibility to easily reconfigure the simulation to address varying SDAS applications (increased sensors, varying formats, etc.).

5.2 CONTROLLED SIGNAL GENERATION EQUIPMENT

The Controlled Signal Generation Equipment will be utilized to provide laboratory controlled voltages to the input multiplexer channels of the SDAS and thus will simulate signals which would be generated by sensors. This simulation capability is required because no sensors are connected to the SDAS until

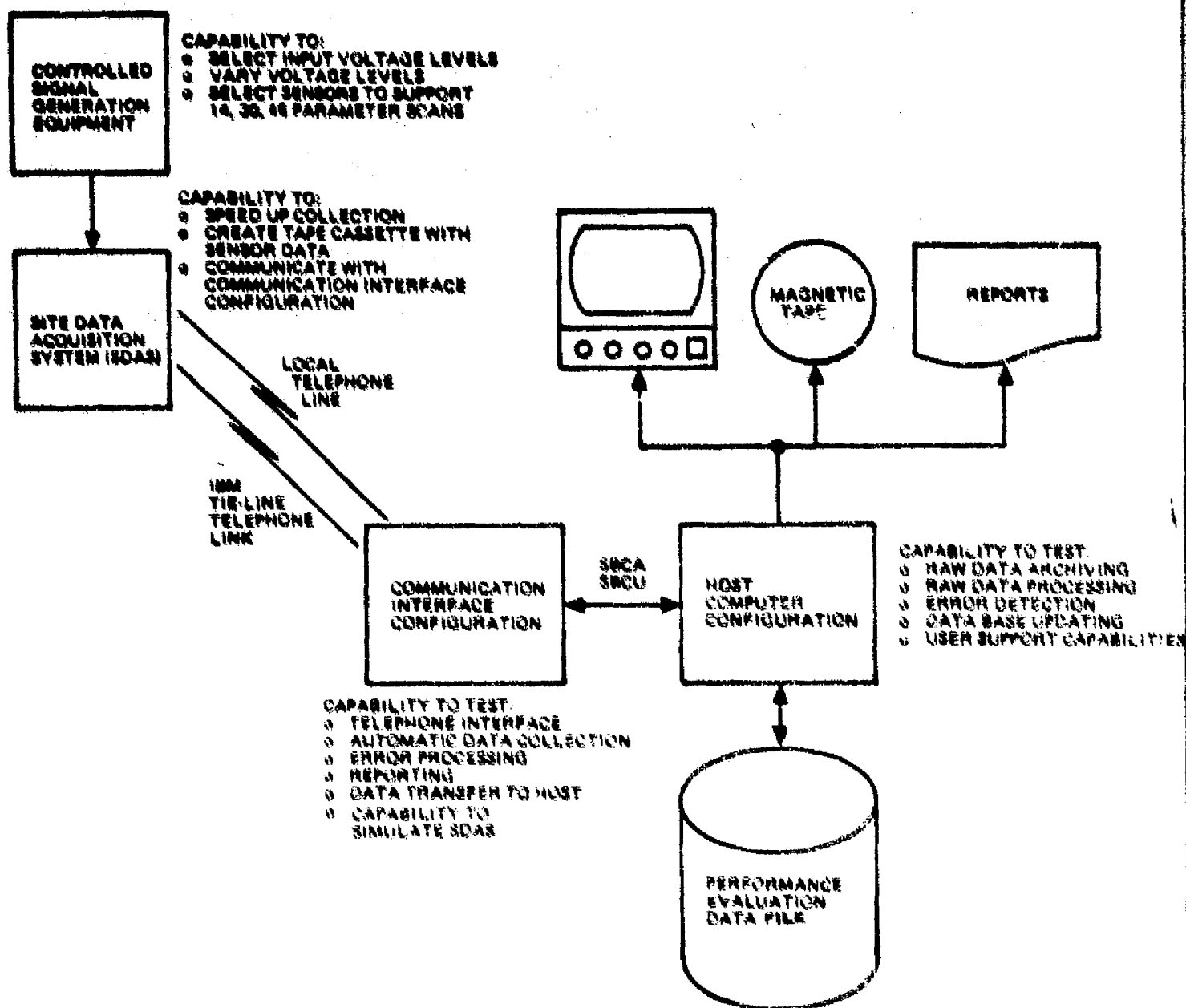


Figure 3, Test Configuration for Data Collection, Data Processing, Data Base Update, User Support Verification

either system testing at MSFC or installation at a remote site. In support of CDPS verification activities, the Controlled Signal Generation Equipment will have the following capabilities:

- o Place voltages onto selected input multiplexer channels of SDAS
- o Support interface to all input multiplexer channels

5.3 SITE DATA ACQUISITION SYSTEM (SDAS)

The SDAS will provide the capability to read the simulated sensor inputs from the Controlled Signal Generation Equipment and record them on cassette tape for subsequent transmission via telephone lines. The prototype SDAS will provide the capability to reduce the sample time to 8 seconds to speed up the data recording process (24 hours of data gathered in .6 hours) and reduce significantly the duration of tests.

5.4 TELEPHONE LINE INTERFACE

To simulate the operational CDPS environment, telephone lines are provided for communication with the prototype SDAS. Two lines (a local line and an IBM tie-line) will be utilized during verification. The local line will be used for development verification to perform debug of SDAS/communication interface configuration interface. The use of a local line reduces communication line errors and thus provides a more controlled environment. During qualification and acceptance verification testing, the IBM tie-line will be used to simulate the use of a long-distance telephone line. These lines are not of high-quality and will provide a realistic testing environment. Calls to the prototype SDAS via the tie-line will be routed to New Jersey and back to the Huntsville facility. This technique is widely used within IBM to test communications between teleprocessing elements and presents a worse-case telecommunications environment for testing.

5.5 COMMUNICATION INTERFACE CONFIGURATION

The communication interface configuration will contain the operational hardware and software undergoing verification. The operational system will collect data from the SDAS via the telephone interface equipment. Communication reports/error messages obtained during data collection can be compared to the reference data provided during the sensor simulation/SDAS data gathering phase. Upon completion of data collection, the data will be transmitted to the host for subsequent processing.

5.6 HOST COMPUTER CONFIGURATION

The host computer configuration (hardware and software) will be an operational system. Data transmitted to the host from the communications interface configuration will be processed and entered into the performance evaluation data base. Error messages/reports generated will be compared with System/7 test reference data for verification purposes.

5.7 PERFORMANCE EVALUATION FILE BASE

The data collected and processed will be entered into the data files and will provide the basis for user support interface verification. Plots/reports/magnetic tapes will be generated from the data and analyzed for correct content/format/etc. SDAS sensor test reference data will be used for reference with user output.

6.0 VERIFICATION CROSS-REFERENCE MATRIX

A verification cross-reference matrix provides a correlation of the CDPS performance specification and the corresponding verification techniques and phases. The verification matrixes for the CDPS are shown in Table 6-1. The matrixes, therefore, provide the base for development of test procedures to address all performance requirements/specification. A separate verification matrix is provided for each CDPS element.

ITEM (NAME AND PART NO.) CENTRAL DATA PROCESSING SYSTEM SOFTWARE		VERIFICATION CROSS REFERENCE MATRIX (Communications Interface)			
VERIFICATION METHOD		1. SIMILARITY 2. ANALYSIS	3. INSPECTION 4. TEST	N/A NOT APPLICABLE	
PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
2.2 Site Directory					
2.2.1 Site Directory Information	4	4	4		
2.2.2 Site Directory Update	4	4	4		
2.2.3 Site Directory Print	4	4	4		
2.3 Communications Hardware Inter face					
2.3.1 Interface Command	1,4	4	4		
2.3.2 Data Integrity	2,4	4	4		
2.3.3 Communications Hardware Status	4	4	4		
2.4 S/7-SDAS Communications	4	4	4		
2.5 Data Store	4	4	4		
2.6 Transmit Data to Host Com- puter	1,4	4	4		
2.7 Manual SDAS Control	4	4	4		

Table 6-1. Verification Matrixes (Sheet 1 of 4)

ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(Input Processing)

VERIFICATION METHOD **1. SIMILARITY** **3. INSPECTION** **N/A NOT APPLICABLE**
2. ANALYSIS **4. TEST**

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
3.2 Accept Raw Data from the S/7.	1	4	4		
3.3 Decommutate Raw Data into Scans	4	4	4		
3.4 Extract Variable and Convert to Engineering Units	4	4	4		
3.5 Converted Variable Testing	4	4	4		
3.6 Compute Performance Evaluation Parameters	4	4	4		
3.7 Generate Input for Data Base Update	4	4	4		
3.8 Create History/Archive Tape	4	4	4		
3.9 Create Input Summary Reports and Error Messages	4	4	4		

Table 6-1. Verification Matrices (Sheet 2 of 4)
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ITEM (NAME AND PART NO.) CENTRAL DATA PROCESSING SYSTEM SOFTWARE		VERIFICATION CROSS REFERENCE MATRIX (File Maintenance)			
VERIFICATION METHOD		1. SIMILARITY 2. ANALYSIS	3. INSPECTION 4. TEST	N/A NOT APPLICABLE	
PERFORMANCE REQUIREMENT		VERIFICATION PHASE			REMARKS
		DEVELOPMENT	QUALIFICATION	ACCEPTANCE	
4.2	Automatic Update of Data Base	1,4	1,4	4	
4.3	Manual Input to Data Base	1	1	4	
4.4	Data Base Maintenance, Access and Update	1	1	4	
4.5	Data Base Security	1	1	4	

Table 6-1. Verification Matrixes (Sheet 3 of 4)

ITEM (NAME AND PART NO.) CENTRAL DATA PROCESSING SYSTEM SOFTWARE		VERIFICATION CROSS REFERENCE MATRIX (User Support)			
VERIFICATION METHOD		1. SIMILARITY 2. ANALYSIS	3. INSPECTION 4. TEST	N/A NOT APPLICABLE	
PERFORMANCE REQUIREMENT		VERIFICATION PHASE			REMARKS
		DEVELOPMENT	QUALIFICATION	ACCEPTANCE	
5.2	Information Retrieval	1	1,4	4	
5.3	Plot Capability	4	4	4	
5.4	Generation of Scheduled Reports	1	1,4	4	
5.5	Magnetic Tape Generation	1	1,4	4	
5.6	Terminal/Batch Capabilities	1	1	4	
6.0	Performance Evaluation Data Base	1,4	4	4	

Table 6-1. Verification Matrixes (Sheet 4 of 4)

7.0 DEVELOPMENT VERIFICATION PLAN

Development verification will be performed as a part of the initial CDPS design activities. Analysis of the proposed designs and testing of initial concepts will be performed to ensure that the CDPS approach selected provides the growth and flexibility to address system specifications in a cost effective manner.

Of prime consideration in development verification will be the utilization of commercially available hardware and software to satisfy CDPS requirements. Trade analysis and performance testing of available capabilities against the CDPS System Performance Specification will provide the bases for selection.

Development verification will consist of detailed testing of each software element, under simulated input conditions, to ensure that the design satisfies the software requirements. These tests will be executed in a standalone environment and will test error paths as well as the normal processing paths.

Upon completion of development verification activities on each software element, detailed tests will be performed, using simulated data, to test interfaces among the software elements. As a result of this interface verification testing, the overall CDPS design will be proven and the system will be available for qualification verification.

Development verification of the hardware will be performed in conjunction with software verification. Ability to satisfactorily perform software development verification will prove the hardware can satisfy the design requirements for each system element.

An interactive relationship will exist among development verification and CDPS design/trade studies/selection processes. Any deficiencies noted in the approach will be discussed and resolved to the satisfaction of the development verification personnel. The interactive relationships will be internal to IBM; however, the results of development verification will be discussed with MSFC at periodic meetings/design reviews.

8.0 QUALIFICATION VERIFICATION PLAN

Upon completion of development verification, qualification verification will be performed. The qualification verification activities will consist of formal tasks performed in the analyses and testing of the elements of the CDPS. Qualification test procedures will be followed throughout the testing phase.

Qualification verification will be performed in a building-block concept. Each system function (hardware and software) will be tested as a unit, and the units combined in an orderly manner to achieve an overall CDPS operational capability. The SDAS will be simulated in the S/7 during unit testing and either the prototype or production SDAS will be used for overall testing. The order in which the elements will be combined and tested during qualification testing is as follows:

- (1) S/7 configuration and SDAS for communication and data collection
- (2) S/7 - S/370 communication to achieve data flow to S/370-145
- (3) Input processing software process data accumulated from S/7
- (4) Data base update capability for user support verification.

Upon completion of qualification testing, the system will be ready to undergo acceptance verification.

Test/analysis results achieved as a result of qualification testing will be compiled into a CDPS Qualification Report. Test procedures will also be contained in the report.

8.1 QUALIFICATION TEST PROCEDURES

Formal qualification test procedures will be generated, provided to MSFC, and utilized during qualification verification activities. The verification cross-reference matrices and the CDPS Performance Specification will provide input required to define and detail these procedures.

Program Trouble and Corrective Action Reports will be generated for each problem encountered. A sample of the form to be completed for discrepancy reporting is shown in Figure 4. Discrepancy reports must be investigated and resolved prior to completion of qualification verification. Reports on status of discrepancies will be included in the qualification report.

8.2 S/7-SDAS CONFIGURATION QUALIFICATION VERIFICATION TESTING

The qualification verification for the S/7-SDAS configuration will ensure that the CDPS can perform the functions associated with telecommunications, data collection and data transmission to the host computer for processing. Functions to be verified are:

- (1) Site Directory Requirements
- (2) Communication Hardware Interface
- (3) S/7-SDAS Communications
- (4) Data Store
- (5) Transmit to Host
- (6) Manual SDAS Control

PROGRAM TROUBLE AND CORRECTIVE ACTION REPORT (PTR)

PTR NO.

PROGRAM NAME		DATE	
INITIATOR		TEST CASE	PROGRAM MODULE ID
DEPT	LOCATION	CLOSURE	DATE

DESCRIPTION OF PROBLEM:

REVIEWER'S SIGNATURE	DATE
-----------------------------	-------------

RESULTS OF INVESTIGATION/RECOMMENDATIONS:

INVESTIGATOR	DATE
---------------------	-------------

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Figure 4. Program Trouble And Corrective Action Report (PTR)

8.3 HOST COMPUTER INPUT PROCESSING QUALIFICATION TESTING

The host computer input processing qualification testing will ensure that the CDPS host computer configuration satisfies all design requirements in the following functional areas:

- (1) S/370-145 to S/7 communication
- (2) Archiving of Raw Data
- (3) Processing of Raw Data
- (4) Computation of Performance Evaluation Parameters
- (5) Generation of Data Base Update
- (6) Summary Reports/Error Messages
- (7) Historical Data Archiving

8.4 FILE MAINTENANCE QUALIFICATION TESTING

The CDPS file maintenance capabilities utilize an existing data base management system which has been proven on other activities. For this reason, qualification testing will consist of a functional test under maximum input conditions to ensure that the capability satisfies the design requirements.

Functional capabilities to be tested are:

- (1) Automatic Update of Data Base
- (2) Manual Input to the Data Base
- (3) Data Base Maintenance, Access, and Update
- (4) Data Base Security

8.5 USER SUPPORT QUALIFICATION VERIFICATION

The user support qualification verification will ensure that the CDPS satisfies the requirements associated with support of data base users. These verification tests will address the following areas:

- (1) Information Retrieval for Report Generation
- (2) Plot Capability
- (3) Daily, Monthly, Annual Reports
- (4) Magnetic Tape Generation
- (5) Terminal/Batch Capabilities

8.6 PERFORMANCE EVALUATION DATA BASE VERIFICATION

Verification of the performance evaluation data base will be accomplished by verifying that data can be added, updated, retrieved, and deleted. Since these capabilities shall be verified in the File Maintenance Software Verification (Section 8.4) and User Support Software Verification (Section 8.5), no further verification of the performance evaluation data base shall be performed.

8.7 OVERALL CDPS QUALIFICATION VERIFICATION TESTING

Upon completion of qualification verification of each of the CDPS elements, overall end-to-end tests will be performed on the system. The test configuration will be as discussed in Section 5 of this report, and the SDAS input will be simulated to provide reference input data. These data will provide the following capabilities:

- (1) Nominal (No Error) Conditions
- (2) Off-Nominal (Error) Conditions
- (3) Variable Formats (14, 30, 46)

Through use of these reference data, system tests can be performed which will provide the basis for entering acceptance testing.

9.0 ACCEPTANCE VERIFICATION PLAN

Upon completion of qualification verification, the CDPS will enter the acceptance verification phase. This phase will exercise the CDPS in a normal operational environment and will provide the capability for testing of operational procedures. The testing configuration will be as shown in Section 5 of this plan, and test data will consist of nominal reference data. Successful completion of acceptance verification will provide an operational CDPS.

The SDAS will be called via IBM tie-lines and data collected by the communication interface configuration. This data will, in turn, be transmitted to the host computer, processed, stored in the data base, and user support functions performed. Output will be provided to analysts to ensure proper content and format.

9.1 ACCEPTANCE VERIFICATION PROCEDURES

CDPS Acceptance Test Procedures shall be developed and used and will provide the test/analysis environment for demonstrating the overall capability of the CDPS in an operational environment.

10.0 CDPS MAINTENANCE VERIFICATION APPROACH

After the CDPS has been declared operational, each requirement change which results in modification to the system will be evaluated for reverification purposes. Those changes which do not impact CDPS inter-element interfaces will undergo development and qualification verification; whereas, those resulting in interface modifications will undergo all verification phases to ensure overall system continuity. Test procedures and test results will be retained for all maintenance verification activities.

SECTION D

CENTRAL DATA PROCESSING SYSTEM DEVELOPMENT PROGRAM

DWG NO.

REVISIONS

CHK	ENGRG NOTICE	LTR	DESCRIPTION	DATE	APPROVD
			Original	5/22/76	<i>[Signature]</i>

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1.0 INTRODUCTION

The Central Data Processing System (CDPS) for support of SIMS data processing requirements must be developed to support the overall solar energy program milestones and must provide the flexibility to support a widely ranging user community. Reliability, flexibility, and availability are the primary development objectives to be satisfied by the CDPS and must be the primary drivers during development of the system. To achieve these objectives, a systematic, well-controlled development must be utilized.

1.1 PURPOSE

The purpose of this development plan is to define IBM's approach to the development of the hardware/software of the CDPS. Included are the development standards, schedules, detailed discussions of the development approach for each system element, and configuration management techniques to ensure development control.

1.2 APPLICABLE DOCUMENTS

The following documents are considered pertinent to the CDPS development plans:

- (1) CDPS Performance Specification Document
- (2) S/370-145 Functional Characteristics
- (3) S/7 Functional Characteristics
- (4) IBM FSD Software Standards Document
- (5) Site Data Acquisition Subsystem Specification Document
- (6) IBM System/7 Teleprocessing Multiplexer
- (7) Programming Guide for S/7 Teleprocessing Feature
- (8) PL/I Programmers Guide
- (9) NIPS Manuals
- (10) Guide to Writing APG Procedures

1.3 LOCATION

The CDPS will be developed on computing facilities located at the IBM facility in Huntsville, Alabama. Development will be performed for MSFC by IBM-FSD personnel at the Huntsville facility.

2.0 CDPS DESCRIPTION

Within the overall Solar Heating and Cooling Demonstration Program, the CDPS performs the following functions:

Data Collection - The CDPS daily collects instrumentation data from all remote sites via standard voice-grade 1200 Baud telephone lines. In addition, non-instrumentation data available from NSFC, ERDA, HUD, etc., which is needed in performing overall system evaluation, is collected via manual means.

Data Processing - The CDPS accepts raw data, as collected by the data collection function, and performs the data processing functions required to transform the raw data into processed information for use in system evaluation/analysis activities. The CDPS also provides the resources to maintain a performance evaluation data base, containing both raw data and processed information, for use in support of performance analysts.

Data Archiving - To provide capability for detailed analyses of system performance and to maintain data for historical purposes, the CDPS provides the capabilities to archive data collected and processed. Both raw data and processed data is retained on magnetic tape, and formal reports are archived in a library.

Data Distribution - In addition to collection, processing, and archiving of data, the CDPS provides the essential function of distributing the data to the appropriate organizations. Distribution is in the form of printed reports, data plots, and magnetic tapes.

3.0 DEVELOPMENT SCHEDULE/FACILITIES

To support NASA need dates for an operational CDPS and to support internal IBM hardware development, IBM has defined an overall CDPS development schedule. The schedule is shown in Figure 1 and includes the development activities for CDPS documentation and software. Overall program milestones to be supported are also shown.

No unique development facilities are required in support of CDPS development. The existing S/7 and S/370-145 computers provide the facilities required for software development.

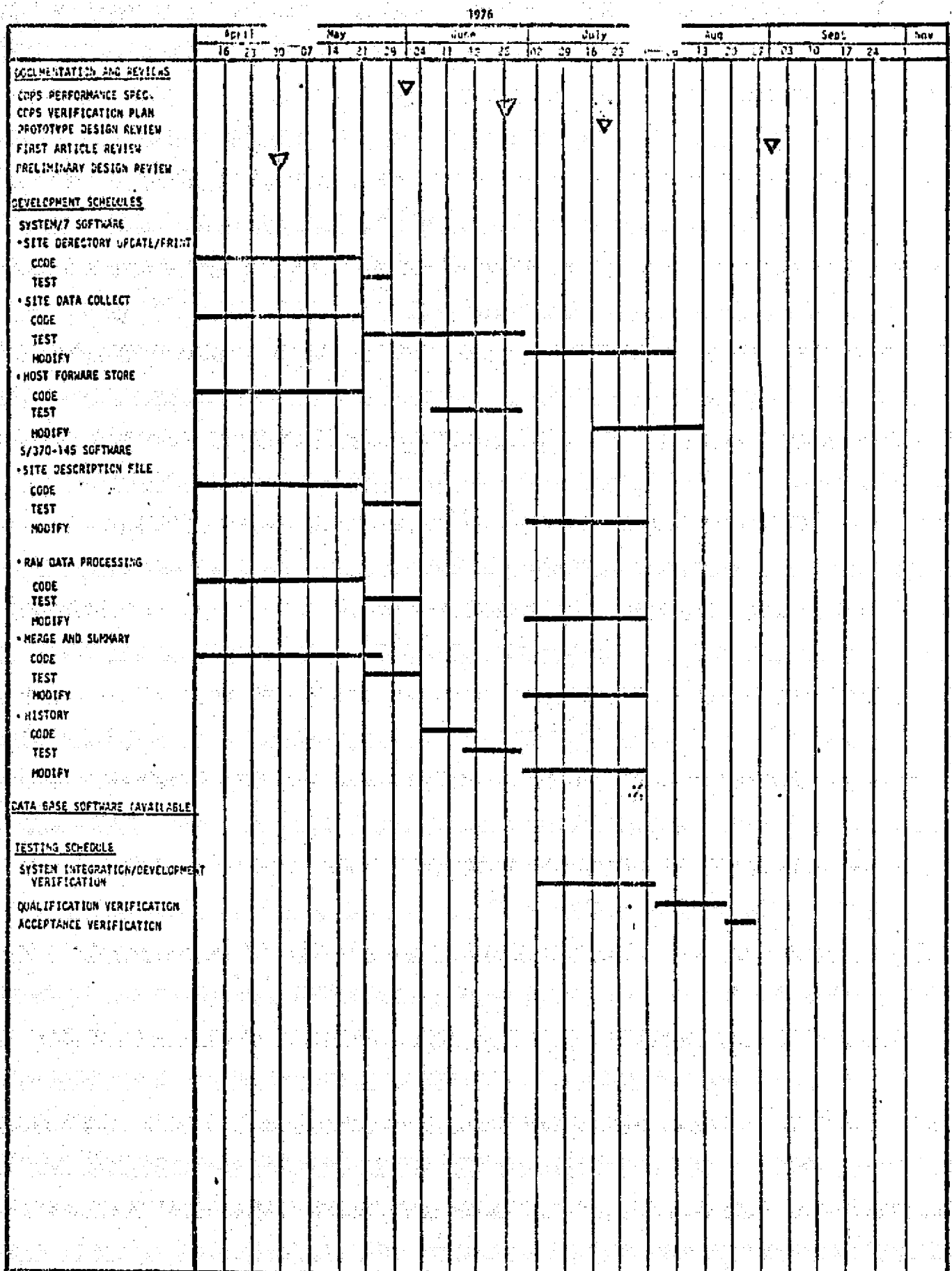


Figure 1. CDPS Development Schedule

4.0 DEVELOPMENT STANDARDS

To ensure reliable and consistent products, standards have been established for both the hardware and software within the CDPS. The following paragraphs address these development standards.

4.1 CDPS HARDWARE

The primary objective is to minimize the development of SIMS-unique hardware. To achieve this objective, commercially available hardware will be used throughout the CDPS. This approach not only avoids the hardware development costs but ensures availability of spare parts in the event of hardware failure. An additional benefit is the availability of personnel to solve hardware problems at no additional cost to the SIMS program.

4.2 CDPS SOFTWARE

The CDPS software development standards encompass the use of advanced software development techniques, the use of a strong software management approach, and maximum use of available software to minimize development costs. The use of those standards in past software development projects has resulted in low-cost, high reliability software. These standards, to be used for SIMS CDPS software development, are discussed in subsequent paragraphs.

4.2.1 Advanced Software Development Techniques

The advanced software development techniques will consist primarily of the use of modular, top-down development concepts and the use of high-order languages. The modular, top-down development concept provides the ability to have an early operational system with reduced capability and to easily add capabilities to the initial system without complete system reverification. The concept also requires a more detailed requirements and design phase which results in fewer changes during software development and utilization. The resulting software is highly structured and, as a result, is easier to maintain throughout its life cycle.

The use of high-order languages will increase programmer productivity and will result in the S/7 computer software being written in APG/7 language and the S/370-145 software being written in PL/I. Each of these languages are commercially available and have been used on many diverse software projects.

4.2.2 Configuration Management Approach

To ensure that CDPS software satisfies system data processing requirements, configuration management techniques will be applied during software development. A software review board will be established, as a subpanel of the SIMS CCB, to control the software development activities. Baseline requirements, software design, and software verification will be reviewed and approved by the review board. Software will be tracked to the module level by the board.

4.2.3 Use of Available Software

To reduce software development costs, maximum use of available software will be achieved. Because of the generality of application the S/7 software and S/370 data bank management systems will consist primarily of existing software.

4.2.4 Use of Standard Forms and Procedures

To achieve a standardization across all software development activities, a set of standard forms and development procedures will be used. Examples of forms for software change requests and software program release notices are shown in Figures 2 and 3. All forms will be assigned unique tracking identification for use in configuration management.

A program library will provide the mechanism for controlling released software. As each module is completed and released for operational use, it will be assigned a unique identification and added to the program library. The library will be controlled by an assigned individual who will be responsible for all additions/deletions effecting the library.

PRN #

I. MODULE RELEASE DATA

MODULE ID _____ DATE _____

PROGRAMMER _____ RELEASE ID _____

SOFTWARE SUBSYSTEM _____ MODULE ID _____

EXECUTE MODE: ☐ RTM ☐ OS
RELEASE TYPE: ☐ RTM ☐ OS/SIM ☐ SP-0 ☐ OFF LINE PROGRAM

II. RELEASE AUTHORITY

☐ INITIAL RELEASE

☐ PTR(S) _____

☐ SWCR(S) _____

☐ NEW CAPABILITIES
(EXPLAIN) _____

III. SOURCE MODULE INFO

A. MODULE LOCATION

☐ CDPS SOURCE ☐ CDPS RELEASE SOURCE

B. SOURCE TYPE

☐ FORTRAN ☐ 360 ASSEMBLER ☐ SP-0 ASSEMBLER ☐ OTHER _____

IV. RELEASE TRACKING (Filled In By Co-Ordinator)

- ☐ VERIFIED IN CDPS RELEASE SOURCE
- ☐ ASSEMBLED/COMPILED SUCCESSFULLY
- ☐ ASSEMBLE/COMPILE FAILURE (NEW PRN REQUIRED)
- ☐ LINK EDITED TO LOAD MODULE SUCCESSFULLY
- ☐ LINK EDIT FAILURE (IF FAILURE ATTRIBUTED TO THIS MODULE)
- ☐ RELEASE COMPLETE

5.0 DEVELOPMENT APPROACH

The CDPS development approach will utilize a building block concept in which each element of the system will be developed and tested in a stand-alone environment, and each element integrated in a systematic manner into the total CDPS. As can be seen in Figure 4, the development of each element occurs in parallel with acceptance verification being performed on the total system immediately preceding the first article review (FAR).

The following paragraphs describe the detailed development approach and schedule for each CDPS element.

5.1 CDPS HARDWARE DEVELOPMENT APPROACH

As was discussed in paragraph 4.1, commercially available hardware will be used throughout the CDPS. All necessary CDPS hardware is presently installed and no further development is planned.

5.2 CDPS SOFTWARE DEVELOPMENT APPROACH

The CDPS software development approach makes maximum benefit of available software and has been scheduled to support overall SIMS program milestones. Detailed schedules and major characteristics of the development activities in each of the CDPS software areas are discussed in the following paragraphs.

5.2.1 Remote Site Interface Software

The remote site interface software, which executes on the S/7 computer configuration, will be developed from baseline software capabilities which are available commercially. The operating system (nucleus) will consist of the S/7 MSP/7 software which provides the capabilities of:

- (1) Interrupt Processing
- (2) Multiple Priority of Processing
- (3) Timer Support
- (4) Peripheral Input/Output Support (Disks, Printers, Teletypes, etc.)
- (5) System Macros

This operating system is generated through the use of the S/7 APG/7 compiler and requires no SIMS development activities.

The operating system provides the basis for use of the top-down development approach for the remote site interface software. Application software which must be developed will be added to the operating system in a systematic manner to achieve the overall S/7 operational capability.

The communication capability within the software will be developed through adaptation of existing software to address the format/transmission requirements of the SDAS to be installed in remote sites.

The development schedule for the remote site interface software has been phased to provide operational software to support the acceptance testing of the initial production unit of the SDAS.

5.2.2 Input Processing Software

The input processing software, which executes on the S/370-145 computer, is the major development activity within the CDPS software. It contains the majority of the software which must address the SIMS-unique requirements; and thus, it cannot be developed from a commercially available base. To support the SIMS program milestones for SDAS development and to provide an early software capability for user interaction, a phased development approach will be utilized. To provide a capability to support acceptance testing of the initial SDAS production unit, the ability to process sensor data for input into the data bank must be provided. This capability will consist of the basic software structure and will provide the following:

- (1) Input Documentation
- (2) Parameter calibration
- (3) Parameter Conversion to Engineering Units
- (4) Preliminary Error Handling
- (5) Data Bank Formatting

The second phase of development will include the definition, design, and implementation of detailed error handling/analysis of SDCS sensor data. Primary objective will be to achieve a highly automated maintenance diagnostic capability for production SDAS units. An additional function of the phase will be to implement software enhancements/capabilities which increase the software usability by system analysts.

5.2.3 Data Bank Management Software

The Data Bank Management Software, which executes on the S/370-145, is the NMCS Information Processing System (NIPS) which is available at no cost to NASA and requires no development activity. The system has been installed on the IBM-FSD Huntsville facility computer and tested to ensure correct operation. In addition, training of programmers has been performed. The remaining development activities to be performed in support of SIMS data processing requirements are: (1) training of analysts in use of the system, (2) detailed design and implementation of data bank, (3) integration testing functions.

5.2.4 User Support Software

The user support software will consist of the output capabilities of NIPS. Flexibility and generality of NIPS should satisfy all requirements of the CDPS without modification to NIPS software.

5.2.5 Support Software

Through use of existing S/370 and S/7 development languages, no development activity will be required to ensuring availability of support software. Personnel assigned to the facility computation center will provide support of this software at no direct cost to SMS program (effort included in cost/hour of computer time).

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6.0 IBM/MSFC REVIEWS

During CDPS development, three reviews will be held between MSFC and IBM to review requirements, status, and products. The preliminary design review (PDR) will be held approximately two weeks after authorization to proceed (ATP) and will provide the means for review of CDPS proposed configuration, CDPS requirements, software design, and available programs, and development plans and schedules.

The prototype review will be held approximately three months after ATP. The principal objectives of the review will be: (1) review of development status, (2) description of CDPS operational characteristics, (3) user's manuals review, and (4) acceptance plan review.

The first article review (FAR) will be held approximately four and one-half months after ATP. Principal objectives will be:

- (1) Acceptance Testing Review
- (2) Users Manual Delivery
- (3) Approval of CDPS as Operational System

SECTION E

QUALIFICATION AND ACCEPTANCE TEST PROCEDURES

DWG NO. 7933442

REVISIONS

CHK	ENGINE NOTICE	LTR	DESCRIPTION	DATE	APPROVED

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DSCR APPROVAL		Qualification and Acceptance Test Procedures	
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SECTION 1

PURPOSE

E-1

1.0 PURPOSE

- Test CDPS processing software in both a standalone test environment and as part of total Central Data Processing System (CDPS)
- Test CDPS software to design limits as specified in the Central Data Processing System Software Performance Specification (MSFC No. DR501-C/IBM No. 7933251)

SECTION 2

SCOPE

E-3

2.0 SCOPE

- Insure through testing that the CDPS software meets or exceeds the design limits baselined in performance specification and design document.
- Testing procedures developed and used to control the testing environment and to insure that all design limits are tested and results documented.

E-4

SECTION 3

APPLICABLE DOCUMENTS

3.0 APPLICABLE DOCUMENTS

- Central Data Processing System Software Verification Plan (MSFC No. DR501-4C/IBM No. 7933198)
- Central Data Processing System Software Performance Specification (MSFC No. DR501-4C/IBM No. 7933251)
- Central Data Processing System Software Development Plan (MSFC No. DR501-4C/IBM No. 7933221)
- Central Data Processing System Software Design Document (July, 1976)

SECTION 4

QUALIFICATION VERIFICATION

E-7

7933462

1.1 QUALIFICATION VERIFICATION APPROACH

- All testing performed on operational CDPS computer hardware
- SDAS simulated on S/7
- Two levels of testing

- Standalone
- Integrated

• Standalone testing characteristics:

- Simulated input through use of S/370-145 "driver" program
- Predictable input parameters used to exercise input processing software
- Error conditions included in data
- Three simulated input cases used to test all error processing, normal processing functions, and report generation

• Integrated testing characteristics:

- Simulated input from S/7 SDAS simulator
- S/370-145 to S/7 interface used to communicate data between systems
- Controlled input simulation to provide predictable test results
- Remote sites with formats of 15, 31, and 47 parameters simulated
- Output for archiving and data file updating will be verified

4.2 COMMUNICATION INTERFACE SOFTWARE QUALIFICATION VERIFICATION

4.2.1 Standalone Testing Approach

- SDAS communication interface simulator used to provide test capability
 - Command/response sequences
 - Communication hardware interface (autocall/telephone lines) simulation
 - 15, 31, and 47 parameter SDAS scan simulation
- Provides means for testing all S/7 operational software with the exception of the actual SDAS/S/7 telephone interfaces

4.2.2 STANDALONE VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/7	COMMUNICATION INTERFACE ☒ INPUT PROCESSING ☐	FILE MAINTENANCE ☐ USER SUPPORT ☐	QUALIFICATION ☒ ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Site Directory Requirements			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 2.2		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)	

TEST NUMBER

2-1

DESCRIPTIONTest Objectives:

- (1) Verify that the Update Site Directory program properly generates the site directory to be used for data collection.
- (2) Establish baseline site directory for use in support of qualification verification

Test Procedures:

- (1) Generate directory entries for remote sites for input via the 5028 teletype interface.
- (2) Load the update site directory program into the S/7.
- (3) Enter the directory update information via the 5028.
- (4) Load the Print Site Directory program and print the directory contents.
- (5) Verify that contents of the directory agree with input requests.

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E-12

CDPS SOFTWARE VERIFICATION PROCEDURE

S/7

COMMUNICATION INTERFACE ☒INPUT PROCESSING ☐FILE MAINTENANCE ☐USER SUPPORT ☐QUALIFICATION ☒ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Site Data Collect Program

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 2.4/2.5

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)

TEST NUMBER

DESCRIPTIONTest Objective:

Verify that the communication interface software properly processes commands and replies and stores data received in proper format on disk.

Test Procedures:

- (1) Use site directory created during test 2-1 for input.
- (2) Load the SDAS simulator and S/7 software from disk.
- (3) Enter the operational data collection mode.
- (4) Monitor 5028 keyboard printer report to ensure that communication and data collection is properly performed.
- (5) Dump the disk containing collected data and verify correct format and contents.
- (6) Dump site directory and verify that parameters associated with collection have been updated.
- (7) Retain collected data for use in subsequent testing.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/7

COMMUNICATION INTERFACE ☒

FILE MAINTENANCE ☐

QUALIFICATION ☒

INPUT PROCESSING ☐

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Site Data Collection

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 2.4/2.5

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)

TEST NUMBER

DESCRIPTION

2-3

Test Objectives: (1) Verify that communication interface software correctly handles the following S/7-SDAS error conditions:

- (a) Data set check errors (Perf. Spec. Table 2-2)
- (b) Data overrun errors (Perf. Spec. Table 2-2)
- (c) System/7 X10 errors (Perf. Spec. Table 2-2)
- (d) Timeout between characters (Perf. Spec. Table 2-2)
- (f) BCH error in received data (Perf. Spec. Table 2-2)
- (g) Software error

(2) Verify that communicate interface software correctly handles communication equipment errors:

- (a) Invalid control word
- (b) Data set not ready
- (c) I/O list busy
- (d) Line closed
- (e) Invalid line number
- (f) I/O overrun

(3) Verify operational retry capability of communication interface software (Table 2-3 of Perf. Spec.)

- (a) Invalid station address received
- (b) BCH error in command
- (c) Invalid command received
- (d) SDAS device failures

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/7

COMMUNICATION INTERFACE ☒

INPUT PROCESSING ☐

FILE MAINTENANCE ☐

USER SUPPORT ☐

QUALIFICATION ☒

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Site Data Collect

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 2.4/2.5

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)

TEST NUMBER

DESCRIPTION

2-3 (Continued)

- Test Procedures:
- (1) Use site directory created during test 2-1.
 - (2) Load SDAS simulator and operational S/7 software.
 - (3) Select manual status mode.
 - (4) Execute S/7 site data collection.
 - (5) Enter status codes to test errors under Test Objectives (1) and (2) above.
 - (6) Verify that S/7 operational software performs as specified in Table 2-2 of Performance Specification for error conditions.
 - (7) Load operational S/7 software into S/7.
 - (8) Enter patches into SDAS to force error conditions described under Test Objective (3).
 - (9) Verify that S/7 software performs as specified in Table 2-3 of Performance Specification for error conditions.

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4.2.3 Integrated Testing Approach

- S/7 is connected to S/370-145 via the SBCU
- Simulated SDAS data obtained from standalone Test 2-2 is transmitted to host for processing

4.2.4 INTEGRATED TESTING PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/7	COMMUNICATION INTERFACE ☒	FILE MAINTENANCE ☐	QUALIFICATION ☒
	INPUT PROCESSING ☐	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: S/7 - S/370-145 Interface			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 2.6		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)	

<u>TEST NUMBER</u>	<u>DESCRIPTION</u>
2-4	<u>Test Objective:</u> Verify that S/7 software (Host Forward Store) properly transmits collected data to S/370-145 via the SBCU. <u>Test Procedures:</u> (1) Use site directory created during Test 2-1. (2) Use collected data created during Test 2-2. (3) Load Host Forward Store program into S/7. (4) Ensure that S/370-145 software to receive data is loaded into S/370-145. (5) Execute Host Forward Store. (6) Dump disk on S/7 containing simulated raw data. (7) Dump disk on S/370-145 containing transmitted data. (8) Compare data to ensure proper data format and content.

4.3 INPUT PROCESSING QUALIFICATION VERIFICATION

4.3.1 Standalone Test Approach

- S/370-145 program written to accept solar parameters from sunfall monitor program magnetic tapes
 - Creates data set in format for processing by input processing software
 - Has capability to create error conditions within data for testing of error processing
 - Error conditions under control of programmer when generating test data
- Three test data cases have been generated for use during standalone qualification verification
 - Case 1 - Normal initial batch of raw data. Only errors are variable out-of-limits, variable change rate exceeds limits, and/or constant variables
 - Case 2 - errors in out-of-limit testing, rate of change, both out-of-limit and exceeding rate of change limits, and non-changing values
 - Case 3 - BCH errors in data, scan time, block start

E-20

4.3.2 STANDALONE VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐

FILE MAINTENANCE ☐

QUALIFICATION ☒

INPUT PROCESSING ☒

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA:

DATE:

PERFORMANCE SPECIFICATION REFERENCE:

VERIFICATION CROSS REFERENCE MATRIX TABLE

TEST NUMBER

DESCRIPTION

3-1

Test Objectives:

- (1) Verify that the Site Description Utility software correctly generates the site data description file.
- (2) Verify that calibration/conversion data is properly entered into the file.

Test Procedures:

- (1) Card images defining the site data description file received for processing of simulated input data will be generated. Cards will include definition of both 8 bit and 10 bit input lengths, all conversion types, and calibration/conversion coefficients.
- (2) Execute Site Description Utility program with detailed print option selected.
- (3) Verify that the listing contains correct data.

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COPS SOFTWARE VERIFICATION PROCEDURE

COPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☐	QUALIFICATION ☒
	INPUT PROCESSING ☒	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)	

TEST NUMBER

3-2

DESCRIPTION

Test Objectives: Verify that the input processing software performs within design limits in the following functions:

- (1) Deconvolution of raw data into scans.
- (2) Extract variables and convert to engineering units.
- (3) Variable testing.
- (4) Compute performance evaluation parameters.
- (5) Generate input for data base update.
- (6) Create history/archive tapes.
- (7) Create input summary reports and error messages.

Test Procedures: (1) Generate Case 1 simulated input which consists of:

- (a) 26 data records (5,128 data bytes)
- (b) Time of previous scan - 73/01/01
Time of present scan - 76/06/29
- (c) Site clock base time - 76/06/29 07.00.00

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐

FILE MAINTENANCE ☐

QUALIFICATION ☒

INPUT PROCESSING ☒

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

DESCRIPTION

3-2 (continued)

Test Procedures:

(d) Time of last scan - 76/06/30 02.15

(e) Following parameters have failure conditions specified:

Parameter ID	Failure	Time of Failure
T600	Change too fast	76/06/29 07.00
TD100	Change too fast	76/06/29 07.00
TD300	No change	

- (2) Execute Raw Input Processing and Merge and Summary programs with detailed print options selected.
- (3) Compare scan times to expected values.
- (4) Compare converted values of variables to expected values.
- (5) Analyze error messages to verify that all messages are correct.
- (6) Compare computed hourly and daily summaries to values determined to be correct through manual computations.
- (7) Compare time intervals and record counts of merges and summary to expected values.
- (8) Retain merge and summary output tape.

CDPS SOFTWARE VERIFICATION PROCEDURE

DPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐FILE MAINTENANCE ☐QUALIFICATION ☒INPUT PROCESSING ☒USER SUPPORT ☐ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

-3

DESCRIPTIONTest Objectives:

Verify that the raw data processing software correctly performs time continuity tests, identifies error conditions outside design limits, provides correct error recovery and messages, and rejects variables which exceed acceptance limits.

Verify that merge and summary software correctly generates merged output files for data bank update and History.

Test Procedures:

- (1) Generate Case 2 simulated input to include variables out-of-limits, values exceeding rate of change limits, variable exceeding rate change and is outside of limits, and frozen readings.
- (2) Execute raw data processing and merge and summary software with detailed print requested.
- (3) Verify that continuity test executed properly.
- (4) Verify that outside-of-limits error message was provided.

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CDPS SOFTWARE VERIFICATION PROCEDURE

PS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐FILE MAINTENANCE ☐QUALIFICATION ☒INPUT PROCESSING ☒USER SUPPORT ☐ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

3 (Continued)

DESCRIPTION

Test Objectives:

- (5) Verify that variable rejection messages are provided.
- (6) Verify error message for non-changing variable. ☐
- (7) Verify that merge and summary time intervals and record counts are correct during data merge.
- (8) Verify that output format for data base update is correct.
- (9) Retain merge and summary output.

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐FILE MAINTENANCE ☐QUALIFICATION ☒INPUT PROCESSING ☒USER SUPPORT ☐ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

3-4

DESCRIPTIONTest Objectives:

Verify that software correctly processes BCH error conditions within the input stream.

Test Procedures:

- (1) Generate Case 3 simulated input to include BCH-errors in data, scan time, and block start.
- (2) Execute raw data processing and merge and summary software.
- (3) Verify correct detection of BCH-errors in data and corresponding error messages.
- (4) Verify that scan which has time with BCH-error is rejected, the corresponding error message is provided and the correct rejected scan record is written.
- (5) Verify that block of data containing block start BCH-error is rejected, written to the rejected scan file, and corresponding error message provided.
- (6) Verify that merged and summarized data has correct format and content.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐
INPUT PROCESSING ☒FILE MAINTENANCE ☐
USER SUPPORT ☐QUALIFICATION ☒
ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBERDESCRIPTION

3-4 (Continued)

Test Procedures: (7) Retain merge and summary output.

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐
INPUT PROCESSING ☒

FILE MAINTENANCE ☐
USER SUPPORT ☐

QUALIFICATION ☒
ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Raw Input Data Archiving

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.8

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

3-5

DESCRIPTION

- Test Objectives:
- (1) Verify that the input processing software catalogs raw input data onto magnetic tapes for archiving.
 - (2) Verify that Site Data Description File is written to magnetic tape with raw data (includes calibration/conversion data for each parameter).
 - (3) Verify that rejected scans and variables are written to magnetic tape.

- Test Procedures:
- (1) Use copied raw data of cases 1, 2, and 3 for input.
 - (2) Execute raw data archiving procedure to create tape containing Case 1, Case 2, and Case 3 raw data and Site Directory.
 - (3) Verify that the magnetic tape created contains the correct raw data and Site Directory contents is properly formatted.
 - (4) Verify that messages associated with processing contain correct information.
 - (5) Verify proper format and content of rejected data files.

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E-29

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐
INPUT PROCESSING ☒

FILE MAINTENANCE ☐
USER SUPPORT ☐

QUALIFICATION ☒
ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: History/Archiving Tape Creation

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.8

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

DESCRIPTION

3-6

Test Objectives: Verify that the History program properly merges processed data into archive tapes.

Test Procedures:

- (1) Use as input the processed data tape containing merged output of tests 3-2, 3-3, and 3-4.
- (2) Execute the History program.
- (3) Verify that the composite History tape contains all data dated prior to History cutoff date.
- (4) Verify that files contain detail data, hourly summaries, and daily summaries.
- (5) Verify that History reports are formatted properly and have correct information.
- (6) Verify that History tapes are in site sequence with data for each site in chronological order.

E-30

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐

FILE MAINTENANCE ☐

QUALIFICATION ☒

INPUT PROCESSING ☒

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Input Summary Reports and Error Messages

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.9

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

DESCRIPTION

3-7

- Test Objectives: (1) Verify that the input processing software correctly generates the following capabilities, reports, and error messages:
- (a) Calibration/conversion values
 - (b) User selection over error message for errors found during processing of raw input. Also user control over summary reports.
 - (c) Data Base Update Input Summary report.
 - (d) History File Update Summary.
 - (e) Summary Report of input processed for each site.
- Test Procedures: (1) Input data will consist of data generated to support test number 3-2.
- (2) Execute test with detailed output option selected and all summary reports requested.
 - (3) Analyze resulting messages/reports for proper content/format.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☐	QUALIFICATION ☒
	INPUT PROCESSING ☒	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Input Summary Reports and Error Messages			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 3.9		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)	

TEST NUMBER

DESCRIPTION

3-7 (Continued)

- Test Procedures:
- (4) Execute test with remaining user selection options to vary detail of output messages and reports.
 - (5) Analyze resulting messages/reports for proper content/format.

4.3.3 Input Processing Integrated Qualification Verification

- S/7 software simulation of SDAS used to generate input data
 - Representative data from remote sites consisting of 15, 31, and 47 samples will be generated
 - Data can be controlled to provide known test environment
 - A complete day's input from remote sites will be generated
 - Data will be formatted and stored on disk for subsequent transfer to S/370-145
- Simulated data will be transferred from S/7 to the S/370-145 via the operational data link for processing by the input processing software
- Data tapes created during input processing will be processed by file maintenance software
- overall objective of integrated qualification verification testing is to ensure that all CDPS software interfaces are verified prior to entry into acceptance testing.

4.3.4 INPUT PROCESSING INTEGRATED QUALIFICATION VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐

FILE MAINTENANCE ☐

QUALIFICATION ☒

INPUT PROCESSING ☒

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Site Description Directory

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 3.4

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)

TEST NUMBER

DESCRIPTION

3-8

Test Objectives: Verify the capability to provide and maintain a Site Description Directory which shall contain a detailed definition of the following for each site:

- (1) Measurement Name
- (2) Location of Measurement within Scan
- (3) Length of Field (1 or 2 bytes)
- (4) Data Base Update Format Position for Converted Value
- (5) Conversion Type
- (6) Conversion/Calibration Coefficients
- (7) Minimum/Maximum Value
- (8) Maximum Acceptable Change Between Successive Readings
- (9) Change/No Change Indicator

Test Procedures:

- (1) Generate card images defining remote site processing requirements for 15, 31, and 47 parameter scans.
- (2) Execute the site data description utility to create site description file for use in performing integrated testing.
- (3) Print contents of description file and verify that file contains correct data.
- (4) Retain file for use in subsequent testing.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE	☐	FILE MAINTENANCE	☐	QUALIFICATION	☒
	INPUT PROCESSING	☒	USER SUPPORT	☐	ACCEPTANCE	☐
SOFTWARE FUNCTIONAL AREA: Raw Data Acceptance From S/7				DATE:		
PERFORMANCE SPECIFICATION REFERENCE: 3.2				VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)		

TEST NUMBER

1-9

DESCRIPTIONTest Objective:

Verify the capability to accept raw data from the S/7 and store for processing.

Test Procedures:

- (1) Execute S/7 simulator to create data for testing.
- (2) Coordinate S/7 and S/370-145 activities to ensure that software/hardware are configured to transfer data.
- (3) Execute data transfer.
- (4) Dump the disk data sets on S/7 and S/370-145 and ensures that data was properly transferred and stored onto S/370-145 disk.
- (5) Retain disk data set for input processing testing.

CDPS SOFTWARE VERIFICATION PROCEDURE

DPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☐	QUALIFICATION ☒
	INPUT PROCESSING ☒	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Raw Data Processing/Merge and Summary			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 3.3 through 3.9		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)	

EST NUMBER

-10

DESCRIPTIONTest Objectives:

Verify the capability of the input processing software to process data created by the S/7 communication interface software and transferred to S/370-145 by the SBCU.

Test Procedures:

- (1) Use disk data set created during test 3-9 as input for test.
- (2) Select detail print option to obtain all error messages and processing status information.
- (3) Execute raw data processing and merge and summary programs.
- (4) Verify that raw input obtained from S/7 is processed correctly through analysis of messages obtained during program execution.
- (5) Retain output for use in testing of file maintenance software.

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4.4 FILE MAINTENANCE QUALIFICATION VERIFICATION

4.4.1 Standalone Testing Approach

- Because of use of a standard data base system, no standalone testing will be performed during qualification verification.

4.4.2 Integrated Testing Approach

- Data tapes created during input processing integrated testing (Test 3-10) will provide test data for file maintenance testing
- Primary objective of testing will be to ensure software compatibility between input processing and file maintenance software

4.4.3 FILE MAINTENANCE QUALIFICATION VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐

FILE MAINTENANCE ☒

QUALIFICATION ☒

INPUT PROCESSING ☐

USER SUPPORT ☐

ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Automatic and Manual Update of Data Base

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 4.2/4.3

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (3 of 4)

TEST NUMBER

DESCRIPTION

4-1

Test Objectives: (1) Verify that tape containing processed remote site data is compatible with the NIPS data base management software and can be used to automatically update the data base.

(2) Verify ability to create data sets for remote sites.

(3) Verify manual data entry capability through update of Site General Description data.

Test Procedures: (1) Use data tape, containing simulated SDAS data created during test number 3-10.

(2) Use file format tables describing remote site operational data set.

(3) Generate site description data and create remote site description file (manual input).

(4) Perform file maintenance run.

(5) Verify through analysis of transaction processing report that all data was accepted and inserted into the data base (manual and automatic).

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☒	QUALIFICATION ☒
	INPUT PROCESSING ☐	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Automatic and Manual Update of Data Base			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 4.2/4.3		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (3 of 4)	

<u>TEST NUMBER</u>	<u>DESCRIPTION</u>
4-1 (Continued)	<u>Test Procedures:</u> (6) Dump data base contents and ensure that both site description file and remote site operational data file contain correct information.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☒	QUALIFICATION ☒
	INPUT PROCESSING ☐	USER SUPPORT ☐	ACCEPTANCE ☐
SOFTWARE FUNCTIONAL AREA: Data Base Security			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 4.5		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)	

TEST NUMBER

4-2

DESCRIPTIONTest Objectives:

Verify that access to the data base can only be achieved through use of proper access codes.

Test Procedures:

- (1) Use data base files created during Test 4-1 for testing of security.
- (2) Generate access requests via card input (Batch) and terminals which use invalid and valid access codes and which attempt to write into data files who only read is authorized.
- (3) Execute data base queries/updates.
- (4) Verify that:
 - o Invalid access codes are rejected
 - o Read only access codes cannot write into files

4.5 USER SUPPORT QUALIFICATION VERIFICATION

4.5.1 Standalone Testing Approach

- Data used for standalone testing will consist of data base created during execution of test Case 4-1.
- Overall objective of testing is to ensure that user support services properly access data base and format data properly for reports, displays, and plots.

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4.5.2 USER SUPPORT QUALIFICATION VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE	☐	FILE MAINTENANCE	☐	QUALIFICATION	☒
	INPUT PROCESSING	☐	USER SUPPORT	☒	ACCEPTANCE	☐
SOFTWARE FUNCTIONAL AREA: Information Retrieval					DATE:	
PERFORMANCE SPECIFICATION REFERENCE: 5.2			VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (4 of 4)			

TEST NUMBER

5-1

DESCRIPTIONTest Objectives:

Verify capability to perform information retrieval of data from data base from both batch and terminal modes.

Test Procedures:

- (1) Use data base created during execution of Test 4-1 for testing.
- (2) Generate information retrieval queries to generate tabular data reports via both batch and terminals
- (3) Execute queries.
- (4) Verify that data presented in reports is same in both batch and terminal modes.
- (5) Compare results to the known contents of the data base to ensure correct retrieval and formatting of data.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐FILE MAINTENANCE ☐QUALIFICATION ☒INPUT PROCESSING ☐USER SUPPORT ☒ACCEPTANCE ☐

SOFTWARE FUNCTIONAL AREA: Plot Capability

DATE:

PERFORMANCE SPECIFICATION REFERENCE: 5.2

VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (4 of 4)

TEST NUMBER

DESCRIPTIONTest Objective:

Verify that the plot capability software properly retrieves data and generates correct plots.

Test Procedures:

- (1) Use data base contents created during execution of Test 4-1.
- (2) Generate test cases for plots of:
 - Parameter versus time
 - Two parameters versus time
- (3) Execute plot test cases via batch and terminal.
- (4) Compare plots obtained via batch and terminal for consistency.
- (5) Compare plots with raw data received from simulated SDAS to ensure that overall CDPS functions have not changed data.

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CDPS SOFTWARE VERIFICATION PROCEDURE

ELEMENT: S/370-145

COMMUNICATION INTERFACE ☐FILE MAINTENANCE ☐QUALIFICATION ☒INPUT PROCESSING ☐USER SUPPORT ☒ACCEPTANCE ☐

WARE FUNCTIONAL AREA: Generation of Scheduled Reports

DATE:

REQUIREMENT SPECIFICATION REFERENCE: 5.4

VERIFICATION CROSS REFERENCE MATRIX TABLE

NUMBER

DESCRIPTION

Test Objective:

Verify that scheduled reports can be generated from data base.

Test Procedures:

- (1) Use data base created during execution of Test 4-1.
- (2) Generate query to access file and format schedules daily and monthly reports.
- (3) Execute query.
- (4) Compare daily summary report contents with expected results.
- (5) Compare Monthly Summary Report contents with expected results.

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CDPS SOFTWARE VERIFICATION PROCEDURE

ELEMENT: S/373-145	COMMUNICATION INTERFACE	☐	FILE MAINTENANCE	☐	QUALIFICATION	☒
	INPUT PROCESSING	☐	USER SUPPORT	☒	ACCEPTANCE	☐
SOFTWARE FUNCTIONAL AREA: Magnetic Tape Generation					DATE:	
PERFORMANCE SPECIFICATION REFERENCE: 5.5				VERIFICATION CROSS REFERENCE MATRIX TABLE		

TEST NUMBER

DESCRIPTIONTest Objective:

Verify capability to generate output on magnetic tape for distribution to outside users.

Test Procedures:

- (1) Use data base created during execution of Test 4-i.
- (2) Generate information retrieval query and procedure for generation of magnetic tape.
- (3) Execute query and procedure.
- (4) Dump magnetic tape.
- (5) Verify that content of tape is same as data base.

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SECTION 5

**ACCEPTANCE
VERIFICATION**

5.1 ACCEPTANCE VERIFICATION APPROACH

- Testing environment includes all operational hardware and software
 - Site data acquisition subsystem (SDAS)
 - Telephone interface between SDAS and S/7 communication interface
 - S/7 communication interface configuration
 - S/370-145 Host computer
- Controlled inputs into SDAS provides predictable data for use in verification
 - 15, 41, and 47 parameter sites are simulated
- Normal operational environment used for acceptance testing
 - Procedures used for control of testing
 - Test Results documented
 - Problems recorded and resolved

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5.2 ACCEPTANCE VERIFICATION PROCEDURES

CDPS SOFTWARE VERIFICATION PROCEDURE

ELEMENT: S/7	COMMUNICATION INTERFACE	☒	FILE MAINTENANCE	☐	QUALIFICATION	☐
	INPUT PROCESSING	☐	USER SUPPORT	☐	ACCEPTANCE	☒
NAME FUNCTIONAL AREA: Manual SDAS Control					DATE:	
REFERENCE SPECIFICATION REFERENCE: 2.7			VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)			

NUMBER

DESCRIPTIONTest Objectives:

Verify that test operator can control communication with SDAS from the S/7 console.

Test Procedures:

- (1) Connect known voltage references to SDAS.
- (2) Create site directory to support testing.
- (3) Execute test SDAS interface software.
- (4) Manually issue each valid command to SDAS and insure proper response.
- (5) Manually issue invalid commands and insure proper response.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/7	COMMUNICATION INTERFACE ☒	FILE MAINTENANCE ☐	QUALIFICATION ☐
	INPUT PROCESSING ☐	USER SUPPORT ☐	ACCEPTANCE ☒
SOFTWARE FUNCTIONAL AREA: Overall Functional Requirements			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 2.1		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (1 of 4)	

TEST NUMBER

1-2

DESCRIPTIONTest Objective:

Verify that the S/7 operational software can communicate with SDAS, and can collect data, and can transfer data to S/370-145 for processing.

Test Procedures:

- (1) Site directory created to include tie-line phone number and collection times.
- (2) Known voltage references connected to SDAS.
- (3) Operational site data collect program executed.
- (4) Upon completion of collection, communication log used to verify proper command interface.
- (5) Disk data sets containing collected data analyzed to ensure that all data properly formatted and stored.
- (6) Retain data set for S/370-145 testing.
- (7) Transmit data to S/370-145 for processing.

CDPS SOFTWARE VERIFICATION PROCEDURE

S ELEMENT: S/370-145	COMMUNICATION INTERFACE	☐	FILE MAINTENANCE	☐	QUALIFICATION	☒
	INPUT PROCESSING	☒	USER SUPPORT	☐	ACCEPTANCE	☐
SOFTWARE FUNCTIONAL AREA:	Overall Functional Requirements				DATE:	
PERFORMANCE SPECIFICATION REFERENCE:	3.1		VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (2 of 4)			

T NUMBER

DESCRIPTIONTest Objectives:

Verify that the input processing software can accept input from S/7, perform processing on raw data, perform merge and summary functions, create data base update tapes, and support archiving/history functions.

Test Procedures:

- (1) Execute raw data acceptance program to receive data from S/7.
- (2) Execute raw data processing and merge and summary programs.
- (3) Execute the History Program.
- (4) Execute the raw data archive procedure.
- (5) Verify error messages and reports to ensure proper processing throughout all steps.
- (6) Retain output for record purposes and for use in file maintenance/user output activities.

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CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE ☐	FILE MAINTENANCE ☒	QUALIFICATION ☐
	INPUT PROCESSING ☐	USER SUPPORT ☐	ACCEPTANCE ☒
SOFTWARE FUNCTIONAL AREA: Overall Functional Requirements			DATE:
PERFORMANCE SPECIFICATION REFERENCE: 4.1		VERIFICATION CROSS REFERENCE MATRIX TABLE	

TEST NUMBER

DESCRIPTIONTest Objective:

Verify capability of file maintenance software to support operational environment.

Test Procedures:

- (1) Accept magnetic tape containing processed data from SDAS.
- (2) Perform automatic data base update functions.
- (3) Verify that all data transactions processed correctly.

CDPS SOFTWARE VERIFICATION PROCEDURE

CDPS ELEMENT: S/370-145	COMMUNICATION INTERFACE	☐	FILE MAINTENANCE	☐	QUALIFICATION	☐
	INPUT PROCESSING	☐	USER SUPPORT	☒	ACCEPTANCE	☒
SOFTWARE FUNCTIONAL AREA: User Support Functional Requirements					DATE:	
PERFORMANCE SPECIFICATION REFERENCE: 5.1			VERIFICATION CROSS REFERENCE MATRIX TABLE 6-1 (4 of 6)			

TEST NUMBER	DESCRIPTION
1-5	<u>Test Objective:</u> Verify that user support software accomodate - operational environment. <u>Test Procedures:</u> (1) Performing the following user support functions using procedures developed during execution of tests 5-1 through 5-4: • Information retrieval • Plot capability • Scheduled reports generation • Magnetic tape generation (2) Verify that outputs reflect the inputs received from the SDAS.

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Prepared for the
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26 October 1976
NAS8-32036
DR 501-14

SECTION F

**Central Data Processing System (CDPS)
Qualification Test and Analysis Report**

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CDPS QUALIFICATION/ACCEPTANCE TEST REPORT

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1. PURPOSE

The purpose of this document is to report the test results obtained in performing the SIMS Central Data Processing System (CDPS) qualification and acceptance testing. The testing was performed between 8/25/76 and 10/1/76 at the IBM Huntsville facility and utilized operational CDPS hardware as the test environment.

Detailed test procedures and results have been retained for future reference.

2. SCOPE

This document addresses the testing performed in verification of the SIMS GDPS and summarizes the results of the testing.

3. APPLICABLE DOCUMENTS

The following documents contain information directly related to CDPS verification testing:

<u>Document Name</u>	<u>Control Number</u>
CDPS Qualification and Acceptance Test Procedures	IBM #7933442
Central Data Processing System Software Verification Plan	IBM #7933198
Central Data Processing System Software Performance Specification	IBM #7933251
Central Data Processing System Software Development Plan	IBM #7933221

4. CDPS TESTING DEFINITION

Verification testing of the CDPS consisted of three distinct levels -- development testing, qualification testing, and acceptance testing. Development testing consisted of software debug performed during development and provided tests of each software element on an individual basis. Qualification and acceptance tests were performed in accordance with the test procedures described in the "CDPS Qualification and Acceptance Test Procedures" document. Results of qualification and acceptance testing were analyzed and provide the data for preparation of this report.

4.1 TEST CONFIGURATION

All testing was performed on the CDPS operational hardware (IBM S/370-145 and S/7 computers and peripherals). Acceptance testing was performed with SDAS #1 to provide an end-to-end test of the data recording/data collection/data processing elements of the system.

4.2 VERIFICATION MATRICES

During performance of all levels of testing, verification matrices were used to ensure that tests addressed are requirements of the "Central Data Processing System Software Performance Specification" document. These matrices were defined to address each of the major processing elements of the software -- communications interface, input processing, file maintenance, and user support. The matrices used in performance of testing are shown in figures 1 through 4.

4.3 CDPS TESTING SUMMARY

Tests were defined to correlate to CDPS requirements with multiple tests being used to provide total verification. The matrices correlating these tests to CDPS requirements are shown in figures 5 through 28. Definitions of test cases are contained in subsequent sections of this document.

ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(Communications Interface)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
2.2 Site Directory					
2.2.1 Site Directory Information	4	4	4		
2.2.2 Site Directory Update	4	4	4		
2.2.3 Site Directory Print	4	4	4		
2.3 Communications Hardware Inter face					
2.3.1 Interface Command	1,4	4	4		
2.3.2 Data Integrity	2,4	4	4		
2.3.3 Communications Hardware Status	4	4	4		
2.4 S/7-SDAS Communications	4	4	4		
2.5 Data Store	4	4	4		
2.6 Transmit Data to Host Com- puter	1,4	4	4		
2.7 Manual SDAS Control	4	4	4		

**CENTRAL DATA PROCESSING
SYSTEM SOFTWARE**

**VERIFICATION CROSS
REFERENCE MATRIX**
(Data Processing)

VERIFICATION METHOD		1. SIMILARITY 2. ANALYSIS	3. INSPECTION 4. TEST	N/A NOT APPLICABLE	
PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
3.2 Accept Raw Data from the S/7.	1	4	4		
3.3 Decommutate Raw Data into Scans	4	4	4		
3.4 Extract Variable and Convert to Engineering Units	4	4	4		
3.5 Converted Variable Testing	4	4	4		
3.6 Compute Per- formance Evalua- tion Parameters	4	4	4		
3.7 Generate Input for Data Base Update	4	4	4		
3.8 Create History/ Archive Tape	4	4	4		
3.9 Create Input Sum- mary Reports and Error Messages	4	4	4		

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Figure 2. Verification Matrixes

ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(File Maintenance)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
4.2 Automatic Update of Data Base	1,4	1,4	4		
4.3 Manual Input to Data Base	1	1	4		
4.4 Data Base Maintenance, Access and Update	1	1	4		
4.5 Data Base Security	1	1	4		
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ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(User Support)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
5.2 Information Retrieval	1	1,4	4		
5.3 Plot Capability	4	4	4		
5.4 Generation of Scheduled Reports	1	1,4	4		
5.5 Magnetic Tape Generation	1	1,4	4		
5.6 Terminal/Batch Capabilities	1	1	4		
6.0 Performance Evaluation Data Base	1,4	4	4		

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COMMUNICATIONS INTERFACE SOFTWARE TESTING

SITE DIRECTORY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Verification Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Maintain on S/7 Disk	2.2	2-1	X	Verified
SDAS Station Address	2.2.1.1	2-1	X	Verified
SDAS Communication Status	2.2.1.2	2-1	X	Verified
SDAS Dial Digits	2.2.1.3	2-1	X	Verified
SDAS Process Requirements	2.2.1.4	2-1,2-2,2-3,2-4	X	Verified
SDAS Data Collection Time	2.2.1.5	2-1	X	Verified
SDAS Error Information	2.2.1.6	2-1,2-2,2-3	X	Verified
Number of Disk Extents	2.2.1.7	2-2	X	Verified
Site Record Index	2.2.1.8	2-2,2-3,2-4	X	Verified
Site Byte Count	2.2.1.9	2-2,2-3,2-4	X	Verified
Initial Realtime Clock	2.2.1.10	2-2,2-3,2-4,1-2	X	Verified
BCH Errors	2.2.1.11	1-2,2-1,2-2,2-3,2-4	X	Verified
Manually Update Directory	2.2.2	2-1,2-2,2-3,2-4	X	Verified
Site Directory Print	2.2.3	2-1,2-2,2-3,2-4	X	Verified

Figure 5

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COMMUNICATIONS HARDWARE INTERFACE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Interface Commands	2.3.1	1-1,1-2,2-3	X	Verified
Data Integrity BCH Errors	2.3.2	2-3,1-2	X	Verified
Hardware Status	2.3.3	2-3	X	Verified
Data Set Check				
Data Overrun				
System/7 XIO Errors				
Software Error				

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SYSTEM 7/ - SDAS COMMUNICATIONS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Command Message Processing	2.4.1	2-3,1-1	X	Verified
Reply Message Processing	2.4.2	2-3,1-1	X	Verified
Normal Reply	2.4.2.1			
Error Reply	2.4.2.2			
Command Definition	2.4.3	2-3,1-1	X	Verified
Command Message Format	2.4.4	2-3,1-1	X	Verified
Reply Message Format	2.4.5	2-3,1-1	X	Verified
Read Tape Reply	2.4.6	1-1,2-2	X	Verified
Communication Report	2.4.7	2-3,1-1,2-2,1-2	X	Verified

Figure 7

DATA STORE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Chained Buffer	2.5	1-2,2-2	X	Verified
Disk Storage	2.5	1-2,2-2	X	Verified
Update Directory	2.5	2-2,2-3,2-4,1-1	X	Verified
Time of Collection	2.5	2-3,1-2	X	Verified

Figure 8

TRANSMIT DATA TO HOST

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Retrieve Data from Disk	2.6	2-4,1-2	X	Verified
Build Header	2.6	2-4,1-2	X	Verified
Update Site Directory	2.6	2-4,1-2	X	Verified
Transmit Data	2.6	2-4,1-2	X	Verified
Error Recovery (*)	2.6	2-4	X	Verified

(*) - Operator error tested hardware errors would require modification of hardware being used by other programs.

Figure 9

MANUAL SDAS CONTROL

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development. Testing</u>	<u>Status</u>
Manually Select Site	2.7	2-2,2-3	X	Verified
Manually Select Commands	2.7	2-2,2-3	X	Verified
Print Replies from SDAS	2.7	2-2,2-3	X	Verified
Print Error Conditions	2.7	2-2,2-3	X	Verified
Selective Print of Site Data	2.7	2-2,2-3	X	Verified

Figure 10

INPUT PROCESSING SOFTWARE TESTING

ACCEPT RAW DATA FROM SYSTEM/7

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
S/370 - S/7 Communications	3.2	2-4,3-9,1-3	X	Verified
Input Format Definition	2.6	2-4,3-9,1-3	X	Verified
Store onto S/370 Disk	3.2	2-4,3-9,1-3	X	Verified
Error Detection/Recovery	3.2	2-4,3-9,1-3	X	Verified (Use of standard system software package)

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Figure 12

DECOMMUTATE RAW DATA INTO SCANS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Separation of BCH's and flags from data	3.3	3-2,3-10,1-3	X	Verified
Locating Block-Starts, End-of-Blocks, and End-of-Sites	3.3	3-2,3-10,1-3	X	Verified
Extract Scans	3.3	3-2,3-10,1-3	X	Verified
Error Processing	3.3	3-2,3-10,1-3	X	Verified

Figure 13

EXTRACT VARIABLES AND CONVERT TO ENGINEERING UNITS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Process Variable Input Formats	3.3	3-10, 3-9 3-1, 3-8	X	Verified
Maintain Site Directory	3.3	3-1, 3-8, 1-3	X	Verified
Calibration/Conversion of Variables	3.3	3-2, 3-10, 1-3	X	Verified

Figure 14

CONVERTED VARIABLE TESTING

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Variables Exceeding Max/Min Limits	3.5	3-2, 3-3, 3-10, 1-3	X	Verified
Variables Exceeding Change Limits	3.5	3-2, 3-3, 3-10, 1-3	X	Verified
Time Continuity	3.5	3-3, 3-10, 1-3	X	Verified
BCII Error Testing	3.5	3-4, 3-10, 1-3	X	Verified
Rejection of Variables	3.5	3-3, 3-4, 1-3	X	Verified
No Change in Variable	3.5	3-3, 1-3	X	Verified
Error Messages	3.5	3-3, 3-4, 1-3	X	Verified
Control Over Printing	3.5	3-7, 1-3	X	Verified

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Figure 15

COMPUTE PERFORMANCE EVALUATION PARAMETERS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Compute Performance Evaluation Parameters	3.6	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Bypass Computations Which Use Erroneous Input Data.	3.6	3-2, 3-3, 3-4, 1-3	X	Verified

GENERATE INPUT FOR DATA BASE UPDATE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Detailed Data	3.7	3-10, 1-3	X	Verified
Hourly Data	3.7	3-10, 1-3	X	Verified
Daily Data	3.7	3-10, 1-3	X	Verified

CREATE HISTORY/ARCHIVE TAPES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Raw Data Archiving	3.8	3-5, 1-3	X	Verified
Processed Data Archiving	3.8	3-6, 1-3	X	Verified
Formatting of Tapes	3.8	3-5, 3-6, 1-3	X	Verified
Printing of Tape Contents	3.8	3-5, 3-6, 1-3	X	Verified

CREATE INPUT SUMMARY REPORTS AND ERROR MESSAGES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Daily Report of Data Base Input	3.9	3-10, 1-3	X	Verified
Monthly Archiving Report	3.9	3-6, 1-3	X	Verified
Daily Input Processing Summary	3.9	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Input Processing Error Messages	3.9	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Site Directory Contents Calibration/Conversion) Report	3.9	3-1, 3-8, 1-3	X	Verified
User Selection of Print Options	3.9	3-7	X	Verified

Figure 19

FILE MAINTENANCE SOFTWARE

AUTOMATIC UPDATE OF DATA BASE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Accept Output of Input Processing Software	4.2	4-1, 1-3	X	Verified
Input Format	4.2	4-1, 1-3	X	Verified
Error Processing	4.2	4-1, 1-3	X	Verified (use standard software)

Figure 20

MANUAL INPUT TO DATA BASE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Manual Entry of Data Via Terminal	4.3	4-1, 1-4	X	Verified
Manual Entry of Data Via Batch	4.3	4-1, 1-4	X	Verified
Editting of Input Format/ Error Processing	4.3	4-1, 1-4	X	Verified Through Use of Standard Software

DATA BASE MAINTENANCE, ACCESS, UPDATE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Support Standard Data Base Management System Capabilities	4.4	---	X	Verified Through Use of Standard Software

Figure 22

DATA BASE SECURITY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Data Base Access Security	4.5	4-2	X	Verified

USER SUPPORT SOFTWARE

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INFORMATION RETRIEVAL

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Support Standard Data Base Information Retrieval Capabilities	5.2	5-1, 1-5	X	Verified

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PLOT CAPABILITY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide Plots of Remotely Recorded Data to Performance Analyst	5.3	5-2, 1-5	X	Verified
Plots Generated for Tektronix 4015/4631 Terminal Unit	5.3	5-2, 1-5	X	Verified

GENERATION OF SCHEDULED REPORTS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Use of Information Retrieval Capability to Access Data Base to Create Standard Reports (Daily and Monthly)	5.4	5-3, 1-4	X	Verified

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MAGNETIC TAPE GENERATION

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide Capability to Generate Magnetic Tapes	5.5	5-4, 1-4	X	Verified

TERMINAL/BATCH CAPABILITIES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide User with Capability to Access Data Base Via Terminal or Batch Methods	5.6	5-1, 1-4	X	Verified

Figure 28

5. CDPS QUALIFICATION TESTING

CDPS qualification testing consisted of test cases which tested the CDPS software in a standalone mode, an integrated system mode using a simulated SDAS, and an integrated system mode using the production SDAS unit #1. These various modes and test cases tested the CDPS software to the design limits as specified in the "CDPS Software Performance Specification". The following paragraphs address qualification test objectives and results.

5.1 COMMUNICATION INTERFACE TESTING

Four test cases were performed in qualification testing of the communication interface software. The relationship between test case and functional software area tested is shown below.

	Test 2-1	Test 2-2	Test 2-3	Test 2-4
Functional Area/Perf. Spec				
Site Directory Requirements/2.2	X			
Site Data Collect/2.4, 2.5		X		
Site Data Collect/2.4, 215			X	
S/7-S/370-145 Interface/2.7				X

Description of each test and the result obtained from each test are discussed in the following paragraphs.

5.1.1 TEST CASE 2-1

Test Objectives:

Verify that the Update Site Directory Program properly generates the Site Directory to be used for data collection.

Test Discussion:

Test was performed on operational S/7 configuration and consisted of the generation of an operational Site Directory containing three sites.

Telephone numbers and processing requirements for each site were entered via the System/7 teletype console. After entry of information, the Site Directory was printed through use of the Site Directory Dump program.

Test Results:

Analysis of the print of the Site Directory (shown in figure 29) indicated that the directory was formatted correctly and contained the correct information.

5.1.2 TEST CASE 2-2

Test Objectives:

Verify that the Communication Interface Software properly processes SDAS command and reply messages and stores data received in correct format for transmission to host computer.

Test Discussion:

The SDAS simulator was used on the S/7 to provide data from three remote sites in the following format:

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OP1:DSD

SITE DIRECTORY DUMP

DATE: 09/01/76

TIME: 00:05

PRINT ALL SITES? - ENTER Y OR N

Y

SITE ID:	1					
SITE STATUS:	0					
TELEPHONE:	00090481128104811481180000000000					
COLLECTION	0 DAY(S)					
LAST DATE	0	0	0	0	0	
ERRORS:	0					
DISK DATA						
SECTOR	0	0	0	0	0	
BYTE CNT	0	0	0	0	0	
YEAR	0	0	0	0	0	
DAY	0	0	0	0	0	
HOUR	0	0	0	0	0	
MINUTE	0	0	0	0	0	
SECONDS	0	0	0	0	0	
BCHERR	0	0	0	0	0	
REPLY	00000000	00000000	00000000	00000000	00000000	

BCTIME

0
0
0
0
0

SITE ID:	2					
SITE STATUS:	0					
TELEPHONE:	00080481129104811481000000000000					
COLLECTION	0 DAY(S)					
LAST DATE	0	0	0	0	0	
ERRORS:	0					
DISK DATA						
SECTOR	0	0	0	0	0	
BYTE CNT	0	0	0	0	0	
YEAR	0	0	0	0	0	
DAY	0	0	0	0	0	
HOUR	0	0	0	0	0	
MINUTE	0	0	0	0	0	
SECONDS	0	0	0	0	0	
BCHERR	0	0	0	0	0	
REPLY	00000000	00000000	00000000	00000000	00000000	

BCTIME

0
0
0
0
0

Figure 29. Site Directory Dump (Page 1 of 2)

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SITE ID: 3
 SITE STATUS: 0
 TELEPHONE: 0008048112S104S1148100000000000
 COLLECTION 0 DAY(S)
 LAST DATE 0 0 0 0 0
 ERRORS: 0
 DISK DATA
 SECTOR 0 0 0 0 0
 BYTE CNT 0 0 0 0 0
 YEAR 0 0 0 0 0
 DAY 0 0 0 0 0
 HOUR 0 0 0 0 0
 MINUTE 0 0 0 0 0
 SECONDS 0 0 0 0 0
 BCHERR 0 0 0 0 0
 REPLY 00000000 00000000 00000000 00000000 00000000
 BCTIME
 0
 0
 0
 0
 0
 0
 SITE DIRECTORY DUMP COMPLETE

Figure 29. Site Directory Dump (Page 2 of 2)

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<u>Site</u>	<u>Data Format</u>
1	15 Parameters (1 multiplexer) 6 - 10 Bit Readings 9 - 8 Bit Readings
2	31 Parameters (2 multiplexers) 12 - 10 Bit Readings 19 - 8 Bit Readings
3	47 Parameters (3 multiplexers) 15 - 10 Bit Readings 32 - 8 Bit Readings

The Site Directory created during Test 2-1 was used to call each site and store collected data. Responses to commands to SDAS provided via manual input to simulator.

One day's simulated data from each site were collected. Simulator provided changing data by incrementing readings for each 5 minute scan.

Upon completion of test, disk and site directory were printed and analyzed for correctness.

Test Results:

Analysis of the Site Directory after completion of the test indicates the following:

<u>Site</u>	<u>Expected Data Volume</u>	<u>Obtained Data Volume</u>
1	9370	9370
2	17610	17610
3	24970	24970

Content of the Site Directory for each remote site is shown in figure 30.

Analysis of the data stored on S/7 disk indicated correct format and content.

TEST CASE 2-2A

Test Objectives:

Verify that the Communication Interface Software properly communicates with and collects data from the operational SDAS.

Test Discussion:

The operational S/7 software was utilized to communicate with the SDAS via telephone lines. Known voltage signals were provided to the SDAS to simulate sensor data.

Three different collections were made from the SDAS to test the software's capability to maintain multiple collections prior to transmission to the host.

Prints of the Site Directory and disk contents were performed to verify correct software execution.

Test Results:

Collection #1 from the SDAS contained 10,210 bytes, collection #2 contained 17,860 bytes, and collection #3 contained 67,840 bytes. The Site Directory was printed after completion of test and proper content was verified.

Analysis/evaluation of S/7 on-line print verified S/7 software's capability to communicate with operational SDAS (see figure 31).

Evaluation of S/7 disk contents verified proper content and format.

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PRINT ALL SITES? - ENTER Y OR N

Y

SITE ID: 1
SITE STATUS: 4
TELEPHONE: 00090481126104811481180000000000
COLLECTION 0 DAY(S)
LAST DATE 76 245 0 31 5
ERRORS: 0
DISK DATA
SECTOR 0 0 0 0 0
BYTE CNT 9370 0 0 0 0
YEAR 76 0 0 0 0
DAY 245 0 0 0 0
HOUR 0 0 0 0 0
MINUTE 30 0 0 0 0
SECONDS 32 0 0 0 0
BCHERR 0 0 0 0 0
REPLY 00000000 00000000 00000000 00000000 00000000
BCTIME
0
0
0
0
0

SITE ID: 2
SITE STATUS: 4
TELEPHONE: 00080481126104811481000000000000
COLLECTION 0 DAY(S)
LAST DATE 76 245 0 32 14
ERRORS: 0
DISK DATA
SECTOR 8 0 0 0 0
BYTE CNT 17610 0 0 0 0
YEAR 76 0 0 0 0
DAY 245 0 0 0 0
HOUR 0 0 0 0 0
MINUTE 31 0 0 0 0
SECONDS 38 0 0 0 0
BCHERR 0 0 0 0 0
REPLY 00000000 00000000 00000000 00000000 00000000
BCTIME
0
0
0
0
0

Figure 10 (Page 1 of 2)

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SITE ID: 3
 SITE STATUS 4
 TELEPHONE: 0008048112810481148100000000C0000
 COLLECTION: 0 DAY(S)
 LAST DATE 76 245 0 33 25
 ERRORS: 0
 DISK DATA
 SECTOR 22 0 0 0 0
 BYTE CNT 24970 0 0 0 0
 YEAR 76 0 0 0 0
 DAY 245 0 0 0 0
 HOUR 0 0 0 0 0
 MINUTE 32 0 0 0 0
 SECONDS 46 0 0 0 0
 BCHERR 0 0 0 0 0
 REPLY 00000000 00000000 00000000 00000000 00000000
 BCTIME
 0
 0
 0
 0
 0
 SITE DIRECTORY DUMP COMPLETE

Figure 30 (Page 2 of 2)

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***** SITE DATA COLLECT PROGRAM 09/26/76 *****

0900:13	DATA COLLECTION FOR SITE 1	
0900:40	DIALING SITE 1	
0900:50	REC'D COMMANDED	
0901:04	REWIND COMMANDED	COLLECTION #1
0902:40	READ TAPE COMMANDED	10,000 + BYTES
0902:52	REWIND COMMANDED	
0902:56	DISCONNECT COMMANDED	

***** SITE DATA COLLECT PROGRAM 09/27/76 *****

0922:24	DATA COLLECTION FOR SITE 1	
0922:43	DIALING SITE 1	
0922:54	REC'D COMMANDED	
0923:07	REWIND COMMANDED	COLLECTION #2
0925:49	READ TAPE COMMANDED	17,000 + BYTES
0926:03	REWIND COMMANDED	
0926:07	DISCONNECT COMMANDED	

***** SITE DATA COLLECT PROGRAM 09/28/76 *****

1020:22	DATA COLLECTION FOR SITE 1	
1020:41	DIALING SITE 1	
1020:52	REC'D COMMANDED	
1021:08	REWIND COMMANDED	COLLECTION #3
1027:35	READ TAPE COMMANDED	67840 BYTES
1027:52	REWIND COMMANDED	
1027:57	DISCONNECT COMMANDED	

Figure 31. Test 2-2A On-Line Log

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5.1.3 TEST 2-3

Test Objectives:

Verify that the Communication Interface Software correctly handles:

- (1) S/7 - SDAS error conditions
- (2) Communication Interface Hardware Errors
- (3) Operational Procedures to Bypass Error Conditions

Test Discussion:

Test was performed in two separate phases - the first using the SDAS simulator and the second using the production SDAS. The simulator was used to test errors associated with (1) and (2) above, and the SDAS was used to test errors associated with (3) above.

In using the SDAS simulator, error conditions were manually entered via the teletype keyboard as responses to commands to the communication equipment or to the SDAS. Analysis of the teletype printer output was used to verify that the Communication Interface Software correctly handled each error condition. In addition, the Site Directory was printed after each error test to ensure that the "Site Status" field was correctly updated.

During phase 2 of the testing, the operational site data collect program was used with the SDAS. The following operational communication problems were tested:

- (1) Unable to call SDAS
- (2) BCH errors during communication
- (3) Time-out between characters
- (4) Time-out of S/7 before SDAS Reply to Command
- (5) Incorrect Site ID from SDAS

Test Results:

Analyses of on-line teletype printer output and print of the Site Directory indicated that the Communication Interface Software performed correctly in responding to error conditions.

Tests performed with S/7 - SDAS configuration indicated correct software operation in handling operational communication errors. Figure 32 contains a sample of the on-line print during error processing.

5.1.4 TEST 2-4

Test Objectives:

Verify that the Host Forward Store software on the S/7 properly formats and transmits collected data to the S/370-145 for processing.

Test Discussion:

Data collected via the use of both the SDAS simulator and the actual SDAS was transmitted to the S/370-145 via the sensor-based control unit (SBCU) for processing.

Prior to transmission to the S/370-145 the Site Directory was printed to determine the number of bytes to be transferred. In addition, for one case, the contents of the S/7 disk was printed prior to transmission. The data received at the S/370-145 was retransmitted to the S/7, printed on the S/7 printer, and analyzed to ensure that the data was identical to that originally transmitted.

During execution of integrated testing, all transmissions between the S/7 and S/370-145 were analyzed to ensure that all data was transmitted.

Proper data format was verified through the S/370-145 software being able to document and process the data.

OR1:SDC

***** SITE DATA COLLECT PROGRAM 09/24/76 *****

0840:11 DATA COLLECTION FOR SITE 1
0840:41 DIALING SITE 1
0841:15 DIALING SITE 1
0841:48 DIALING SITE 1
0842:21 DIALING SITE 1
0842:27 UNABLE TO DIAL SITE 1 TPM STATUS - 15
0842:30 DATA COLLECTION FOR SITE 2
0843:05 DIALING SITE 2
0843:39 DIALING SITE 2
0844:12 DIALING SITE 2
0844:45 DIALING SITE 2
0844:51 UNABLE TO DIAL SITE 2 TPM STATUS - 15
0844:54 HARD FAILURE

***** SITE DATA COLLECT PROGRAM 09/24/76 *****

2333:16 DATA COLLECTION FOR SITE 1
2333:39 DIALING SITE 1
2333:50 REOF COMMANDED
2334:02 REWIND COMMANDED
2336:39 READ TAPE COMMANDED
2336:43 TPM ERROR STATUS 40 ATTEMPTING RETRY
2336:55 REWIND COMMANDED
2339:36 READ TAPE COMMANDED
2339:39 TPM ERROR STATUS 40 ATTEMPTING RETRY
2339:52 REWIND COMMANDED
2342:32 READ TAPE COMMANDED
2342:35 TPM ERROR STATUS 40 ATTEMPTING RETRY
2342:48 REWIND COMMANDED
2345:28 READ TAPE COMMANDED
2345:32 TPM ERROR STATUS 40 ATTEMPTING RETRY

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***** SITE DATA COLLECT PROGRAM 09/27/76 *****

2145:37 DATA COLLECTION FOR SITE 1
2145:56 DIALING SITE 1
2146:07 REOF COMMANDED
2146:42 REWIND COMMANDED
2146:45 TPM ERROR STATUS 15 ATTEMPTING TO REDIAL SITE
2146:49 TPM ERROR STATUS 15 ATTEMPTING TO REDIAL SITE
2147:14 DIALING SITE 1
2147:27 REOF COMMANDED
2147:50 REWIND COMMANDED
2147:53 TPM ERROR STATUS 9 ATTEMPTING TO REDIAL SITE
2147:57 TPM ERROR STATUS 9 ATTEMPTING TO REDIAL SITE
2148:24 DIALING SITE 1
2148:36 REOF COMMANDED
2149:11 REWIND COMMANDED
2149:15 TPM ERROR STATUS 15 ATTEMPTING TO REDIAL SITE
2149:18 TPM ERROR STATUS 15 ATTEMPTING TO REDIAL SITE

Figure 32. Operational Communication Error Handling

Test Results:

During execution of tests, approximately 100,000 bytes of data were transmitted between the S/7 and the S/370-145 without failures.

No errors were encountered in processing data formats.

5.2 INPUT PROCESSING SOFTWARE TESTING

Ten test cases were performed during verification of the input processing software on the S/370-145. These test cases included standalone testing using input data created from existing Sunfall Monitor data tapes and integrated testing using data created via both the SDAS simulator and actual SDAS. The following table summarizes the areas of requirements tested with each test.

INPUT PROCESSING REQUIREMENTS	TEST 3-1	TEST 3-2	TEST 3-3	TEST 3-4	TEST 3-5	TEST 3-6	TEST 3-7	TEST 3-8	TEST 3-9	TEST 3-10
Accept Raw Data From S/7									X	X
Extract Variables/Convert	X	X	X	X			X	X		X
Test Converted Variables	X	X	X	X			X	X		X
Compute Performance Eval. Pars		X					X			X
Generate Data Base Input	X	X	X	X			X	X		X
Create History/Archive Tapes		X	X	X	X	X				X
Input Summary Reports/Errors		X	X	X	X	X	X			X

5.2.1 TEST 3-1

Test Objectives:

Verify that the Site Description Utility Software correctly generates the Site Data Description File.

Test Discussion:

Card images describing a site with the following scan characteristics were created and used to generate a Site Data Description File entry.

- (1) Scan contains 26 variables
- (2) Both 8 and 10 Bit Variables includes
- (3) Conversion types of linear, quadratic, and discrete
- (4) Conversion tables for each variable
- (5) Maximum/minimum values
- (6) Maximum change limits
- (7) Change Indicator

The card images were processed by the Site Description Utility Program and a print of the resulting data file was analyzed for correctness.

Test Results:

The analysis of the Site Data Description File indicated that the correct file entry was generated and contained the proper data. Resulting report is shown in figure 33.

5.2.2 TEST 3-2

Test Objectives:

Verify that the input processing software performs within design limits in the areas of:

SITE DATA INFORMATION FILE UTILITY PROGRAM
SITE ID 00003

PAGE 1

DATE: 08/25/76
TIME: 1405

GENERAL INFORMATION REPORT

00003 SITE ID
HW SYSTEM TYPE
12 PRINT LEVEL
20 SCAN LENGTH
C TIME ZONE
600 COLLECTOR AREA

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Figure 33. Site Description File Report

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SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID: 00003

PAGE 2
DATE : 08/25/76
TIME : 1453

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	NIPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	MAXIMUM CHANGE	MUST CHNG?
EP101	19	2	2	L	0.000	0.125	0.000	0.000	0.000	100.000	25.000	NO
EP300	4	1	3	L	0.000	1.000	0.000	0.000	0.000	256.000	10.000	YES
EP301	16	1	4	L	0.000	0.100	0.000	0.000	0.000	256.000	30.000	YES
EP401	15	1	6	L	0.000	0.100	0.000	0.000	0.000	30.000	10.000	YES
EP402	8	1	7	D	0.000	8.000	0.000	0.000	0.000	1.000	1.000	NO
EP501	8	1	9	D	0.000	8.000	0.000	0.000	0.000	1.000	1.000	NO
F300	7	1	10	L	0.000	0.100	0.000	0.000	0.000	256.000	10.000	YES
F400	11	1	11	L	0.000	0.100	0.000	0.000	0.000	50.000	5.000	NO
F500	10	1	12	L	0.000	0.100	0.000	0.000	0.000	25.000	20.000	YES
I001	1	1	13	L	20.000	1.000	0.000	0.000	0.000	276.000	20.000	YES
T001	13	1	15	L	-458.000	3.000	0.000	0.000	-20.000	110.000	90.000	YES
T600	18	1	26	Q	70.000	0.000	0.002	0.000	45.000	90.000	45.000	YES
TD100	17	1	29	L	20.000	0.100	0.000	0.000	20.000	40.000	20.000	YES
TD300	6	1	31	L	20.000	1.000	0.000	0.000	20.000	276.000	25.000	YES
TD301	3	1	32	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
TD302	3	1	33	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
TD400	3	1	34	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
TD401	3	1	35	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
TD402	3	1	36	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
TD500	3	1	39	T	20.000	0.000	0.000	1.000	0.000	100.000	22.000	YES
W100	12	1	41	L	0.000	1.000	0.000	0.000	0.000	256.000	10.000	YES
W300	9	1	42	L	0.000	1.000	0.000	0.000	0.000	256.000	10.000	YES
W301	2	1	43	L	0.000	0.100	0.000	0.000	0.000	25.000	24.000	YES
W400	5	1	44	L	0.000	0.100	0.000	0.000	0.000	256.000	20.000	YES

Figure 33. Continued

SITE DATA INFORMATION FILE UTILITY PROGRAM
 UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
 SITE ID 00003

PAGE 5
 DATE 09/25/76
 TIME 1453

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	MLPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	EXTENSION LENGTH	TEST CHECK
#600	14	1	47	L	0.000	10.000	0.000	0.000	0.000	2000.000	2000.000	YES
#601	14	1	48	L	0.000	0.050	0.000	0.000	0.000	10.000	10.000	YES

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Figure 33. Continued

- (1) Input Decommutation
- (2) Extract Variables and Convert to Engineering Units
- (3) Testing of Variables
- (4) Performance Evaluation Factors Computation
- (5) Data Base Input Generation
- (6) Create History/Archive Tapes
- (7) Input Summary/Error Messages

Test Discussion:

A test case data set was generated to be used in performance of this test. This test data consisted of:

- (1) 26 Data Records (5, 128 Bytes)
- (2) Beginning time of data - 76/6/29/0000
Last data time - 76/6/30/0215
- (3) Failure condition (no change/changing too fast) for selected parameters

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The test was performed in a 'standalone' environment and used the Site Directory defined in Test 3-1.

Test Results:

To verify the capability to perform input decommutation, extract variables, convert to engineering units, and test variables, a comparison of results expected to obtained was performed (shown in figure 34)

To verify the software's capability to generate hourly and daily summary data, a comparison of expected to actual was performed. The comparison matrix is shown in figure 35.

Error messages and summary reports were analyzed for accuracy of content. No problems were noted.

<u>VARIABLE</u>	<u>NAME</u>	<u>TITLE</u>	<u>EXPECTED VALUES/ERRORS</u>	<u>OBTAINED VALUES/ERRORS</u>
EP101		76/6/29 0700	15.0	15.0
EP300		76/6/29 0705	0.0	0.0
T600		76/6/29 0710	72.4	72.39
TD301		76/6/29 0715	21.0	21.0
EP501		76/6/29 0720	0.0	0.0
Q100		76/6/29 0725	0.05	0.05
N113		76/6/29 0730	85.0	85.0
T600		76/6/29 0700	Changing Too Fast	Changing Too Fast
TD100		76/6/29 0700	Changing Too Fast	Changing Too Fast
TD300		---	No Change	No Change

Figure 34. Comparison of Expected to Actual Results

<u>SUMMARY</u>	<u>LEVEL</u>	<u>VARIABLE</u>	<u>TIME</u>		<u>EXPECTED</u>	<u>OBTAINED</u>
Hourly		T001	76/6/29	0759	79.80	79.80
Hourly		TD300	76/6/29	0859	20.0	20.0
Hourly		D001	76/6/29	0959	-99999	-99999
Daily		T001	76/6/30	2359	77.04	77.04
Daily		TD300	76/6/30	2359	20.0	20.0
Daily		D001	76/6/30	2359	-99999	-99999

F-55

Figure 35. Hourly/Daily Summary Comparison

5.2.3 TEST 3-3

Test Objectives:

Verify that the Raw Data Processing Software correctly performs the following:

- (1) Time Continuity Testing
- (2) Error Processing
- (3) Error Recovery/Reporting
- (4) Variable Rejection

Test Discussion:

Test case data set was generated which included the following error conditions:

- (1) Variable outside of acceptance limits
- (2) Variables exceeding change rate between successive
- (3) Variables not changing

Total of 232 scans of input data between times of 76/6/30 0220 and 76/6/30 2135 generated.

Test was performed in a 'standalone' environment.

Test Results:

Time continuity testing demonstrated the software's capability to retain time of last scan previously processed and perform tests against initial time of new data. No problems encountered.

Error Processing/Recovery/Reporting was verified through analysis of summary reports and error messages. Comparison of expected to actual results is shown in figure 36.

<u>VARIABLE</u>	<u>TIME</u>	<u>EXPECTED ERROR</u>	<u>ACTUAL ERROR</u>
W301	76/6/30 0530	Out of Limits	Out of Limits
W301	76/6/30 0825	Out of Limits	Out of Limits
W301	76/6/30 0825	Changed too fast	Changed too fast
W301	76/6/30 0825	Rejected	Rejected
W301	76/6/30 0830	Changed too fast	Changed too fast
W301	76/6/30 1425	Out of Limits	Out of Limits
W301	76/6/30 1430	Changed too fast	Changed too fast
TD300	---	No change	No change

Figure 36. Comparison of Expected to Actual Results for Test 3-3

5.2.4 TEST 3-4

Test Objective:

Verify that Input Processing Software correctly processed BCH errors in input stream.

Test Discussion:

Test case data set generated which contained BCH errors within data fields, scan time field, and data block time fields.

Data set contained 256 data scans and covered time interval from 76/6/30 2145 to 76/7/1 1655.

Test Results:

Analysis of error summary and error messages indicated that a total of 1 complete scan and 1 complete data block were rejected because of BCH errors. Results agreed with expected results.

Figure 37 summarizes the results associated with BCH in data field.

5.2.5 TEST 3-5

Test Objectives:

Verify that the Input Processing Software correctly performs the following functions:

- (1) Catalogs Raw Input Data
- (2) Writes Site Directory contents to tape with archived raw data
- (3) Writes rejected scans/variables/blocks to tape

Test Discussion:

Test data sets created for Tests 3-2, 3-3, and 3-4 used as input to test. During test, data and directory contents written to tape for archiving simulation.

<u>VARIABLE</u>	<u>TIME</u>	<u>EXPECTED ERROR</u>	<u>ACTUAL ERROR</u>
EP300	76/6/30 2145	BCH Error	BCH Error
EP402	76/6/30 2145	BCH Error	BCH Error
EP501	76/6/30 2145	BCH Error	BCH Error
F300	76/6/30 2145	BCH Error	BCH Error
I001	76/6/30 2145	BCH Error	BCH Error
TD300	76/6/30 2145	BCH Error	BCH Error
TD301	76/6/30 2145	BCH Error	BCH Error
TD302	76/6/30 2145	BCH Error	BCH Error
TD400	76/6/30 2145	BCH Error	BCH Error
TD401	76/6/30 2145	BCH Error	BCH Error
TD402	76/6/30 2145	BCH Error	BCH Error
TD600	76/6/30 2145	BCH Error	BCH Error
W301	76/6/30 2145	BCH Error	BCH Error
W400	76/6/30 2145	BCH Error	BCH Error

Figure 37. BCH Errors in Data Fields for Test 3-4

Test Results:

Magnetic tape contents were analyzed for proper content. As shown in figure 38, no problems were encountered.

5.2.6 TEST 3-6

Test Objectives:

Verify that the History Program within the Input Processing Software properly merges processed data onto archive tapes.

Test Discussion:

Processed data generated during execution of Tests 3-2, 3-3, and 3-4 used as input to History Program.

Test was executed with a history cutoff time of 76/6/30 2359 in order to write all data prior to that time to History Files.

Test Results:

Analysis of summary messages indicated that all data (detail hourly, and daily) occurring prior to 76/6/30 2359 was written to tape.

History tape was printed and correct content was verified through analysis of data.

5.2.7 TEST 3-7

Test Objectives:

Verify that the Input Processing Software properly generates the required reports and error messages.

Verify that user can control the level of detail to be included in reports and error messages.

<u>DAY</u>	<u>EXPECTED SITE DIRECTORY RECORDS</u>	<u>OBTAINED SITE DIRECTORY RECORDS(*)</u>	<u>EXPECTED DATA RECORDS</u>	<u>OBTAINED DATA RECORDS(*)</u>
1	3	3	27	27
2	3	3	27	27
3	3	3	28	28

* - Correct Data in Records

Figure 38. Raw Data Archiving Results (Test 3-5)

Test Discussion:

Input data to the test consisted of test data generated for Test 3-2.

Test consisted of several reruns of test data with varying selection options for detail of output reports.

Test Results:

For each output option selected, the test was executed. The reports, error messages, summary of processing, etc., were analyzed for expected content. No problems were encountered.

5.2.8 TEST 3-8

Test Objective:

Verify the capability to provide and maintain a Site Description Directory for each site.

Test Discussion:

Test data was generated to describe 3 remote sites with data formats containing 15 parameters per scan, 31 parameters per scan, and 47 parameters per scan respectively. For each site, the definition included:

- (1) Measurement Name
- (2) Location of measurement within scan
- (3) Length of data field
- (4) Data base input definition
- (5) Conversion type
- (6) Conversion/Calibration coefficients
- (7) Maximum/Minimum values
- (8) Maximum change between successive reading
- (9) Change/No change indicator

The Site Data Description Utility program was used to read the input data and generate the directory entries. Contents of the directory were printed and analyzed for correctness.

Test Results:

As shown in Figure 39, the Site Data Descriptions for each site were created properly and contained the correct information.

5.2.9 TEST 3-9

Test Objective:

Verify the capability to accept raw data from the S/7 and store for processing.

Test Discussion:

The SDAS simulator and actual SDAS were used to generate and collect data on the S/7 for transfer to the S/370-145. The data collected on the S/7 was printed prior to transmission, transmitted to the S/370-145, stored onto disk, and subsequently processed by the input processing software.

Test Results:

Verification of the contents of data sets on the S/7 and S/370-145 ensured that correct data transfer occurred. In addition, analysis of input processing summary outputs verified that correct number of data bytes were processed.

5.2.10 TEST 3-10

Test Objectives:

Verify the overall CDPS capability to collect data, transfer from S/7 to S/370-145, and process data on the S/370-145 (overall CDPS interface test).

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID 00001

PAGE 1

DATE : 09/02/76
TIME : 1021

*GENERAL INFORMATION REPORT

SITE ID

SYSTEM TYPE

PRINT LEVEL

SCAN LENGTH

TIME ZONE

COLLECTOR AREA

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Figure 39.

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID 00001

PAGE 2

DATE : 09/02/76
TIME : 1021

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	NIPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	MAXIMUM CHANGE	MUST RING?
SP01	1	2	49	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
0001	3	2	1	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP101	5	2	2	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP300	7	2	3	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP301	9	2	4	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP400	11	2	5	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP401	13	2	6	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP402	15	1	7	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP403	16	1	8	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP501	17	1	9	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP300	18	1	10	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP400	19	1	11	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP500	20	1	12	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
1001	21	1	13	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
1002	22	1	14	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
1001	23	1	15	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

Figure 39. Continued

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SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID 00002

PAGE 3

DATE : 09/02/76
TIME : 1021

GENERAL INFORMATION REPORT

00002	SITE ID
4	SYSTEM TYPE
12	PRINT LEVEL
45	SCAN LENGTH
C	TIME ZONE
600	COLLECTOR AREA

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Figure 39. Continued

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID 00002

PAGE 4

DATE : 09/02/76
TIME : 1021

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEV	NIPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	MAXIMUM CHANGE	JUST CHNG?
SP01	1	2	49	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
0001	3	2	1	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP101	5	2	2	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP300	7	2	3	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP301	9	2	4	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP400	11	2	5	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP401	13	2	6	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP402	15	1	7	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP403	16	1	8	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP501	17	1	9	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F300	18	1	10	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F400	19	1	11	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F500	20	1	12	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T001	21	1	13	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T002	22	1	14	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T001	23	1	15	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T100	24	2	16	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T101	26	2	17	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T102	28	2	18	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T200	30	2	19	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T201	32	2	20	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T300	34	2	21	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T301	36	1	22	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T400	37	1	23	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

Figure 39. Continued

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ORIGINAL PAGE IS

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF RE-REPLACING A SITE **
SITE ID 00002

PAGE 3
DATE : 09/02/76
TIME : 1021

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	NIPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	MAXIMUM CHANGE	TEST RESULT
T500	38	1	24	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T501	39	1	25	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T600	40	1	26	L	0.000	1.	0.000	0.000	0.000	1024.000	1024.300	YES
T601	41	1	27	L	0.000	1.000	0.000	0.000	0.000	1024.020	1024.000	YES
T602	42	1	28	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
TD100	43	1	29	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
TD101	44	1	30	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
TD300	45	1	31	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

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Figure 39. Continued

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF ** REPLACING A SITE **
SITE ID 00003

PAGE 8

DATE : 07/02/76
TIME : 1021

GENERAL INFORMATION REPORT

G0003	SITE ID
HC	SYSTEM TYPE
12	PRINT LEVEL
64	SCAN LENGTH
C	TIME ZONE
600	COLLECTOR AREA

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Figure 39. Continued

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF REPLACING A SITE
SITE ID 00003

PAGE 7

DATE : 05/02/76
TIME : 1021

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	NIFS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	PERCENT CHANGE	MUST CHECK
SP01	1	2	49	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
DO01	3	2	1	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP101	5	2	2	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP300	7	2	3	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP301	9	2	4	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP400	11	2	5	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP401	13	2	6	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP402	15	1	7	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP403	16	1	8	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
EP501	17	1	9	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F300	18	1	10	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F400	19	1	11	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
F500	20	1	12	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T001	21	1	13	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T002	22	1	14	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T001	23	1	15	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T100	24	2	16	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T101	26	2	17	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T102	28	2	18	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T200	30	2	19	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T201	32	2	20	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T300	34	2	21	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T301	36	1	22	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T400	37	1	23	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

Figure 39. Continued

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF 99 REPLACING A SITE 99
SITE ID 00003

DATE : 09/02/76
TIME : 1921

CORED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	HTPS POS	CONV. TYPE	CONV. #1	CONV. #2	CONV. #3	CONV. #4	MINIMUM VALUE	MAXIMUM VALUE	MAXIMUM CHANGE	MUST CHANGE
T500	38	1	24	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T501	39	1	25	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T600	40	1	26	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T601	41	1	27	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T602	42	1	28	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0100	43	1	29	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0101	44	1	30	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0300	45	1	31	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0301	46	2	32	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0302	48	2	33	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0400	50	2	34	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0401	52	1	35	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0402	53	1	36	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0500	54	1	37	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0501	55	1	38	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0600	56	1	39	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0601	57	1	40	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M100	58	1	41	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M300	59	1	42	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M301	60	1	43	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M400	61	1	44	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M500	62	1	45	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M501	63	1	46	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
M600	64	1	47	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

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Figure 39. Continued

Test Discussion:

SDAS simulator on S/7 used to simulate collection of data from three remote sites. Approximately one day's data (288 scans) from each site was simulated. No errors were included in the data.

Data was transmitted to S/370-145 by the S/7 software and an operational processing cycle was performed on the S/370-145 to verify overall system interfaces. Results of input processing phase were retained for use in data base update testing.

Test Results:

As shown in figure 40, each site's data was processed with no error conditions encountered.

As shown in figure 41, the data base update input contained all expected data from each site.

5.3 DATA BASE UPDATE TESTING

Qualification of the Data Base Software included two basic test cases which emphasized the capabilities to update and maintain the SINS performance evaluation data bank and to ensure security of access to the data bank. Because a data base management system of proven capabilities was used for data base support functions, detailed software testing was not performed. Input to test cases consisted of data generated during execution of Test 3-10 (see paragraph 5.2.10).

5.3.1 TEST CASE 4-1

Test Objectives:

Verify that the data base management system has the capabilities to:

SITE DATA INFORMATION FILE UTILITY PROGRAM
UTILITY RUN FOR PURPOSE OF RE-REPLACING A SITE
SITE ID 00000

PAGE 8

DATE : 09/02/76
TIME : 1921

CODED MEASUREMENTS REPORT

MEASUREMENT	SCAN POS	LEN	NTPS POS	CONV TYPE	CONV #1	CONV #2	CONV #3	CONV #4	MINIMUM VALUE	MAXIMUM VALUE	EXTENSION CHANGE	MUST CHANGE
T500	38	1	24	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T501	39	1	25	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T600	40	1	26	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T601	41	1	27	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T602	42	1	28	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T9100	43	1	29	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0101	44	1	30	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0300	45	1	31	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0301	46	2	32	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0302	48	2	33	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0400	50	2	34	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0401	52	1	35	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0402	53	1	36	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0500	54	1	37	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0501	55	1	38	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
T0600	56	1	39	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W001	57	1	40	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W100	58	1	41	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W300	59	1	42	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W301	60	1	43	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W400	61	1	44	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W500	62	1	45	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W501	63	1	46	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES
W600	64	1	47	L	0.000	1.000	0.000	0.000	0.000	1024.000	1024.000	YES

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Figure 39. Continued

Test Discussion:

SDAS simulator on S/7 used to simulate collection of data from three remote sites. Approximately one day's data (288 scans) from each site was simulated. No errors were included in the data.

Data was transmitted to S/370-145 by the S/7 software and an operational processing cycle was performed on the S/370-145 to verify overall system interfaces. Results of input processing phase were retained for use in data base update testing.

Test Results:

As shown in figure 40, each site's data was processed with no error conditions encountered.

As shown in figure 41, the data base update input contained all expected data from each site.

5.3 DATA BASE UPDATE TESTING

Qualification of the Data Base Software included two basic test cases which emphasized the capabilities to update and maintain the SIMS performance evaluation data bank and to ensure security of access to the data bank. Because a data base management system of proven capabilities was used for data base support functions, detailed software testing was not performed. Input to test cases consisted of data generated during execution of Test 3-10 (see paragraph 5.2.10).

5.3.1 TEST CASE 4-1

Test Objectives:

Verify that the data base management system has the capabilities to:

RAW DATA PROCESSING SUMMARY				RUN TIME 76/09/02 19.31	
EXPLANATION OF ERROR CODES					
15 - SITE FAILED					
10 - A BLOCK OF DATA REJECTED					
8 - A SCAN REJECTED					
4 - DATA VALUE REJECTED					
SITE_ID	ERROR_CODE	FIRST_SCAN_TIME	LAST_SCAN_TIME	#SCANS_OUTPUT	
00001	0	76/09/01 01.30	76/09/02 00.25	288	
00002	0	76/09/01 00.31	76/09/02 00.26	299	
00003	0	76/09/01 00.32	76/09/02 00.27	299	
TOTAL #SCANS_OUTPUT		864			
TOTAL NUMBER OF SITES PROCESSED 3					
NUMBER OF SITES PROCESSED SUCCESSFULLY 3					
NUMBER OF SITES FOR WHICH PROCESSING FAILED 0					
HIGHEST ERROR CODE 0					

Figure 40

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MERGE & SUMMARY DETAIL RECORD REPORT

RUN TIME 76/09/02 19.36
PAGE 1

SITE_ID	RECORDS FROM OLD DATA BASE			RECORDS FROM NEW INPUT			DISCARDED COUNT	RECORDS TO TODAY'S DATA BASE								
	FIRST TIME	LAST TIME	COUNT	FIRST TIME	LAST TIME	COUNT		FIRST TIME	LAST TIME	COUNT						
00001	00/00/00	00.00	00/00/00	00.00	0	76/09/01	00.30	76/09/02	00.25	288	0	76/09/01	00.30	76/09/02	00.25	288
00002	00/00/00	00.00	00/00/00	00.00	0	76/09/01	00.31	76/09/02	00.26	288	0	76/09/01	00.31	76/09/02	00.26	288
00003	00/00/00	00.00	00/00/00	00.00	0	76/09/01	00.32	76/09/02	00.27	288	0	76/09/01	00.32	76/09/02	00.27	288
ALL_SITES					0					864	0					864

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Figure 41

- (1) Process tapes generated during the input processing activities and update the performance evaluation data bank
- (2) Generate data bank entries for remote sites which include non-instrumentation data
- (3) Accept non-instrumentation data via manual means

Test Discussion:

The File Structure (FS) application program of the NIPS system was used to structure the Site Description File (DESCRIP) and three sub-files (SCAN, HOURLY and DAILY) to contain the site parameter data which was generated by the Input Processing System.

File Maintenance (FM) was performed against the 'DESCRIP' file using card input data to build site description information for sites 00001, 00002 and 00003.

File Maintenance using two disk data sets and one tape data set which were generated by the Input Processing Subsystem. These data sets were used to build the 'SCAN' (site detail scan data), 'HOURLY' (scan data accumulated into hourly data) and 'DAILY' (hourly scan data accumulated into daily data) Files.

The contents of the three files (SCAN, HOURLY and DAILY) were printed in the same format as that printed by input processing when its output data sets were created to verify the data base contents with the input provided by input processing.

The contents of the 'DESCRIP' file was printed to compare with the card input data used as input to the file.

Terminal input using the Source Data Automation (SODA) capability of NIPS was performed, changing the site name of site 00003 from 'QUAL/VERIF TEST SITE THREE' to 'QUAL/VERIF TEST OF SODA FOR SITE THREE' SODA capability to change all files in the DESCRIP file were generated - listings provided for the SODA change capability on the 'DESCRIP' file.

Test Results:

Analysis of the print of the data base contents showed that the data was identical to that generated by the input processing software.

Analysis of data base content also showed that non-instrumented data input was correct.

5.3.2 TEST 4-2

Test Objectives:

Verify that access to the data base can only be achieved through use of proper access codes.

Test Discussion:

Testing of the terminal security required that the Terminal Processing Monitor be provided with a table showing valid terminal 'Logon' codes and file access authorization.

Four signon codes were provided along with a special code which provided access to all files for both reading and writing.

These codes were:

WALL	-	LGAA
BARN	-	LGAA
RYAN	-	LGAB
AQUILA	-	LGAA
SYSGR	-	ALOK(*)

The files were provided access authorization in the following manner:

<u>File Name</u>	<u>Authorization</u>	<u>Capability</u>
DESCRIP	LGAA	Read/Write
HOURLY	LGAA	Read Only
SCAN	LGAA	Read Only
DAILY	LGAA	Read Only
SIMWEA	LGAB	Write Only

*Note: SYSMGR has authorization to all files for both read/write.

Test Results:

- I. Terminal logon was attempted in the following manner with indicated results.

<u>TERMINAL INPUT</u>	<u>SYSTEM RESPONSE</u>
1. LOGON 1234-R	'LOGON MSG WAS NUMERIC' 'LOGON NOT ACCEPTED'
2. LOGON RYAN-R	'LOGON REQUEST ACCEPTED'
3. LOGON SMITH-R	'YOU ARE NOT AUTHORIZED TERMINAL DISABLED' (*)

*A message 'Unauthorized User Attempting to use Terminal DD62260A, Check on NIPS Console Bldg. 5-3' was generated at the S-145 operator console. The NIPS terminal was deactivated until the computer operator enabled it.

- II. Once 'LOGON' was successful an attempt was made to access a file for which there was no authorization. File "HOURLY" with access code of LGAA was accessed by RYAN with access code of LGAB with the following results:

TERMINAL INPUTSYSTEM RESPONSE

'FILE HOURLY.	'EOM RECEIVED'
LIST ROSLD.-Q	'QUIP STARTED'
	'APPLICATION PROGRAM TERMINATED DUE TO INVALID ACCESS'
	'YOU CAN'T HAVE ACCESS TO FILE'

The computer operator was sent a message 'Terminal DD62260A unauthorized to use file HOURLY' giving him the indication that someone had attempted to access a file for which they were not authorized.

- III. The 'DESCRIP' file was structured with a classification of solar. A further test of file security was performed to ensure that of the correct logon code was showing and had access to a particular file, that the classification of the file was also required. The terminal session resulted in the following:

TERMINAL INPUTSYSTEM RESPONSE

LOGON SYSMGR-R	'LOGON ACCEPTED'
FILE DESCRIP.	'CLASS OPERATOR REQUIRED'
LIST SITEID.-Q	

The proper file classification was then given, thusly:

FILE DESCRIP.	
CLASS SOLAR.	
LIST SITEID.-Q	'SITE IDENTIFICATION 00001 00002 00003'

- IV. To test the ability to read a file that is write only a QUIP was run against the SIMWEA file as shown:

<u>TERMINAL INPUT</u>	<u>SYSTEM RESPONSE</u>
LOGON RYAN-R	'LOGON RECEIVED'
FILE SIMWEA.	'QUIP STARTED'
LIST SDASA-Q	'APPLICATION PROGRAM TERMINATED DUE TO INVALID ACCESS'
	'YOU CANNOT HAVE ACCESS TO FILE'

- V. A Source Data Automation (SODA) file maintenance set of statements was generated to test the capability of 'write' inhibit for a read only file (HOURLY). (See listing for job D268SOD.)

When the file maintenance to update fields of file 'HOURLY' was attempted the results were as follows:

<u>TERMINAL INPUT</u>	<u>SYSTEM RESPONSE</u>
LOGON WALL-R	LOGON REQUEST ACCEPTED
FILE HOURLY REPORT SOD	EOM RECEIVED
X00004HF76091200005H-F	FMSODA STARTED
	INPUT SCRATCHED. READY FOR MORE.
UPDATE-F	EOM RECEIVED
	***ERROR** UNAUTHORIZED ATTEMPT TO UPDATE FILE TYPE CANCEL ALL-F TO SIGNOFF
CANCEL ALL-F	EOM RECEIVED
	ALL UPDATES TO HOURLY CANCELLED
	SIGNOFF ACCEPTED HOURLY

5.4 USER SUPPORT SOFTWARE TESTING

User support verification was accomplished through the performance of four test cases. The input to these test cases consisted of the data base created during performance of Test 4-1 (see paragraph 5.3.1). The correlation of test cases to user support requirements is shown in the following matrix.

USER SUPPORT REQUIREMENTS	TEST 5-1	TEST 5-2	TEST 5-3	TEST 5-4
Information Retrieval	X			
Plot of Parameters		X		
Report Generation			X	
Magnetic Tape Gen.				X

Discussion of objectives and results of each test is presented in the following paragraphs

5.4.1 TEST 5-1

Test Objective:

Verify the capabilities of the user support software to perform information retrieval from the data bank. Retrieval must be supported in both batch and technical access modes.

Test Discussion:

BATCH MODE

Information retrieval queries using the QUIP capability of the NIPS system were performed against the 'DESCRIP', 'SCAN', 'HOURLY' and 'DAILY' files to obtain the indicated data elements.

QUIP #1 - Accessed the 'DESCRIP' file to obtain the following elements:

- a. SITEID (site identification)
- b. SYSID (system type)
- c. SITNAM (site name)

QUIP #2 - Accessed the 'SCAN' file to obtain:

- a. ROSID (site identification)
- b. (date)
- c. (time)
- d. Null (parameter)

QUIP #3 - Accessed the 'HOURLY' file to obtain:

- a. (site identification)
- b. (date)
- c. (time)
- d. Null (parameter)

QUIP #4 - Access the 'DAILY' file to obtain:

- a. (site identification)
- b. (date)
- c. (time)
- d. Null (parameter)

The contents were compared against the data base contents obtained in Test 4-1 to ensure correctness.

TERMINAL MODE

During terminal session queries were made identical to those performed in the batch mode (section A) and the results compared for verification.

Test Results:

Analysis of information retrieval results against data base contents through comparison indicated no problems in information retrieval capability.

5.4.2 TEST 5-2

Test Objective:

Verify the user support capability to provide plots of data on Tektronix 4015 display.

Test Discussion:

The plot capability of the system was exercised in both the batch and terminal modes.

BATCH

A batch job was submitted to retrieve twenty-four hours of data (one day) from the 'HOURS' file consisting of parameter N111 for date 760901, site #00003. This data was used by the plot program to generate a Tektronic 4015 plot of the parameter.

TERMINAL

The 'PRAM' field of the terminal plot program was modified to obtain a plot for date 760901 and site 00003. The results of the plot output were compared to that obtained in the batch mode.

Test Results:

Comparison of plots to data within the data base indicated that correct data was presented on the plot. Example of plot is shown in figure 42.

5.4.3 TEST 5-3

Test Objective:

Verify the capability to provide scheduled reports to users.

Test Discussion:

The 'DESCRIP', 'SCAN', 'HOURLY', and 'DAILY' files were accessed and the data formatted in the scheduled report configuration. The resultant output reports were compared with the data content of the files for consistency.

Test Results:

Analysis of report content to data base contact through comparison indicated that correct data was contained in reports.

5.4.4 TEST 5-4

Test Objective:

Verify the capability to provide users with magnetic tapes containing data base information.

Test Discussion:

Using a query to generate a plot for parameters N111 versus N406 for site 00003 the resultant data was written to a magnetic tape (job D208RIT1). The contents of the tape was printed (job D208RIT) and compared to the data base content.

Test Results:

Comparison of magnetic tape content to data base content indicated correct data was written to magnetic tape.

6. ACCEPTANCE TESTING

Acceptance testing of the CDPS consisted of an end-to-end system test. All elements of the hardware (SDAS, telephone lines, system/7, and S/370-145) and software (S/7 and S/370-145) were included in the test. Known voltage references were attached to the SDAS. These reference signals were recorded by the SDAS and collected from the SDAS by the S/7 via telephone lines. This data was then used as a test case to verify the operational capabilities of the CDPS.

Figures 43 - 45 contain a summary of the results of acceptance testing and show that the overall flow of data from end-to-end is correct and consistent at each system interface.

6.1 COMMUNICATION INTERFACE ACCEPTANCE TESTING

6.1.1 TEST 1-1

Test Objective:

Verify that the test engineer can utilize the S/7 manual interface capability to test SDAS operation at remote site.

Test Discussion:

The manual S/7 software was loaded into the S/7 and all commands were manually issued to the SDAS via telephone lines. Both the command issued by the test engineer and the responses received from the SDAS were printed for analysis.

Both valid and invalid commands were issued during the test to ensure that invalid commands were rejected by the system.

Test Results:

Analysis of on-line communication log indicated correct operation of the manual interface capability.

ACCEPTANCE TEST SUMMARY

CHANNEL	INPUT VOLTAGE	S/7 INPUT	S/370-145 INPUT PROCESSING		INPUT PROCESSING ERRORS		DATA BASE PROCESSING	
			OBTAINED	EXPECTED	EXPECTED	OBTAINED	EXPECTED	OBTAINED
A01	0000 (0V)	0040 (Noise)	100.1°F	100.117°	None	None	100.1	100.1
A02	0000 (3.75V)	0000 (3.75V)	30°F	30.0°F	None	None	30.0	30.0
A03	0000 (0V)	0040 (Noise)	60°F	60.097°F	None	None	60.0	60.0
A04	0000 (45mV)	0000 (45mV)	75°F	75.07°F	Out of Limits	Out of Limits	75.0	75.0
A05	0000 (0V)	0080 (Noise)	160.1°F	160.19°F	None	None	160.1	160.1
A06	0000 (45mV)	0000 (45mV)	-99999.0	-99999.0	None	None	-99999.0	-99999.0
A07	0000 (0V)	0000 (0V)	30.0	30.0	None	None	30.0	30.0
A08	0000 (0mV)	0000 (0mV)	-99999.0	-99999.0	None	None	-9999.0	-9999.0
A09	0000 (0mV)	0000 (0mV)	30.0	30.0	None	None	30.0	30.0
A10	0000 (0mV)	0000 (0mV)	0.0	0.0	None	None	0.0	0.0
A11	0000 (0mV)	0000 (0mV)	100.0	100.0	None	None	100.0	100.0
A12	0000 (75mV)	0000 (75mV)	794.4	794.4	Out of Limits	Out of Limits	794.4	794.4
A13	0000 (0V)	0000 (0V)	0.0	0.0	None	None	0.0	0.0
A14	0000 (75mV)	0000 (75mV)	1213.7	1213.779	Out of Limits	Out of Limits	1213.7	1213.7
A15	0000 (0V)	0000 (0V)	0.0	0.0	None	None	0.0	0.0

Figure 43. Multiplexer A Input

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ACCEPTANCE TEST SUMMARY

CHANNEL	INPUT VOLTAGE	S/7 INPUT	S/370-145 INPUT		S/370-145 ERRORS		DATA BASE PROCESSING	
			EXPECTED	ACTUAL	EXPECTED	ACTUAL	EXPECTED	ACTUAL
B00	C000	C000	1213.78	12.13.7	Out of Limits	Out of Limits	1213.7	1213.7
B01	C000	C000	0.0	0.0	None	None	0.0	0.0
B02	C050	C000	397.20	397.1	Out of Limits	Out of Limits	397.1	397.1
B03	C000	0040	.097752	0.0	None	None	0.0	0.0
B04	C000	C000	9.91	9.9	Out of Limits	Out of Limits	9.9	9.9
B05	C000	0040	.097752	0.0	None	None	0.0	0.0
B06	C000	C000	0	0	None	None	0	0
B07	C000	FFC0	100.1	100.0	Out of Limits	Out of Limits	100.0	100.0
B08	C000	C000	0.0	0.0	None	None	0.0	0.0
B09	C000	0040	-49.805	-49.8	None	None	-49.8	-49.8
B10	C000	0040	0.0	0.0	None	None	0.0	0.0
B11	C000	0040	-49.805	-49.8	None	None	-49.8	-49.8
B12	C000	0040	0.0	0.0	None	None	0.0	0.0
B13	C000	0040	-49.805	-49.8	None	None	-49.8	-49.8
B14	C000	0040	0.0	0.0	None	None	0.0	0.0
B15	C000	0040	30.166	30.1	None	None	30.1	30.1

Figure 44. Multiplexer B Input

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ACCEPTANCE TEST SUMMARY

CHANNEL	INPUT VOLTAGE	S/7 INPUT	S/370-145 INPUT		S/370-145 ERRORS		DATA BASE PROCESSING	
			EXPECTED	ACTUAL	EXPECTED	ACTUAL	EXPECTED	ACTUAL
C00	0000	0000	0.0	0.0	None	None	0.0	0.0
C01	0000	0000	30.0	30.0	None	None	30.0	30.0
C02	0000	0040	-99999.0	-99999.0	None	None	-99999.0	-99999.0
C03	0000	0040	30.166178	30.1	None	None	30.1	30.1
C04	0000	0000	-99999.0	-99999.0	None	None	-99999.0	-99999.0
C05	0000	0000	100.0	100.0	None	None	100.0	100.0
C06	0000	0000	0.0	0.0	None	None	0.0	0.0
C07	0000	0000	100.0	100.0	None	None	100.0	100.0
C08	0000	0080	-99999.0	-99999.0	None	None	-99999.0	-99999.0
C09	0000	0040	100.097752	100.0	None	None	100.0	100.0
C10	0000	0080	100.195	100.1	None	None	100.1	100.1
C11	0000	0000	100.0	100.0	None	None	100.0	100.0
C12	0000	0000	100.0	100.0	None	None	100.0	100.0
C13	0000	0000	-99999.0	-99999.0	None	None	-99999.0	-99999.0
C14	0000	0080	.194	.1	None	None	.1	.1
C15	0000	0000	-99999.0	-99999.0	None	None	-99999.0	-99999.0

Figure 45. Multiplexer C Input

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6.1.2 TEST 1-2

Test Objective:

Verify that the S/7 operational software can:

- (1) Communicate with SDAS via telephone lines
- (2) Collect data from SDAS
- (3) Store data onto disk
- (4) Transfer data to S/370-145

Test Discussion:

S/7 operational software was used to collect from the SDAS 5 consecutive times prior to data transfer to S/370-145. This tested the maximum limit on collection/storage/data transfer requirements.

In addition, a single collection was performed, printed on the S/7 printer, transferred to the S/370-145, and a comparison made to ensure that correct data was transferred. This single collection test data was used for acceptance testing of S/370-145 software and consisted of 10,720 bytes (approximately one day's volume for one site).

Test Results:

Analysis of the command sequence printed on the teletype printer verified correct sequence of commands. Dump of site directory after each collection verified that site directory entries associated with data storage locations and volume were correctly handled.

Analysis of S/7 - S/370-145 data transfer verified correct operation of system.

6.2 INPUT PROCESSING ACCEPTANCE TESTING

TEST 1-3

Test Objective:

Verify that the input processing operational software can:

- (1) Accept data from S/7
- (2) Perform raw data processing
- (3) Perform memo and summary processing
- (4) Generate data base update
- (5) Perform data archiving

Test Discussion:

Site directory for site #1 generated and used during input processing phase to control input decommutation and parameter conversion/calibration functions.

Input to test consisted of data collected from SDAS by S/7 (known input). Operational processing performed on input. Detail print options selected to provide data for verification analyses.

Data base update data file created for use in testing data base software.

Test Results:

Detailed comparison of results obtained during input processing with those expected with known input indicated that data decommutation, conversion/calibration, and parameter testing areas of software performed properly.

History and archive data were compared to expected, and no problems were found.

6.3 DATA BASE ACCEPTANCE TESTING

TEST 1-4

Test Objective: Verify the capability of the data base system to support the operational environment.

Test Discussion: Using data sets generated by input processing files 'SCAN', 'HOURLY' and 'DAILY' were structured and updated using File Structuring (FS) and File Maintenance (FM) capability of NIPS. A new 'DESCRIP' (Site Description Data) file was generated for site 00001 HC using FS and FM procedures.

Test Results: To verify the contents of the four files Output Processing (OP) was used to produce reports of the file data. This data was compared to the input data generated by Input Processing and found to be the same.

6.4 USER SUPPORT ACCEPTANCE TESTING

TEST 1-5

Test Objective: Verify that the user support capability of the CDFS accommodate the operational environment.

Test Discussion: The following runs were performed against the data base to produce user reports/outputs:

- (1) Scheduled report generation
- (2) Information retrieval
- (3) Magnetic tape generation
- (4) Plot of selected parameters

Test Results: Comparison of content of all output with expected (content of data base) indicated that user support capabilities function properly.

SECTION G

QUALIFICATION AND ACCEPTANCE TESTING REVIEW

CDPS

QUALIFICATION AND ACCEPTANCE TESTING REVIEW

PURPOSE

- Test CDPS processing software in both a standalone test environment and as part of total Central Data Processing System (CDPS)
- Test CDPS software to design limits as specified in the Central Data Processing System Software Performance Specification (MSFC No. DR501-C/IBM No. 7933251)

CDPS TESTING LEVELS

- Development Testing
- Qualification Testing
- Acceptance Testing

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DEVELOPMENT TESTING

- Perform on CDPS hardware
- Consisted on detailed software debug tests performed by programmers during software development
- Purpose of testing was to ensure that software satisfied requirements at lowest levels

QUALIFICATION TESTING

- All testing performed on operational CDPS computer hardware
- SDAS simulated on S/7
- Two levels of testing
 - Standalone
 - Integrated
- Standalone testing characteristics:
 - Simulated input through use of S/370-145 "driver" program
 - Predictable input parameters used to exercise input processing software
 - Error conditions included in data
 - Three simulated input cases used to test all error processing, normal processing functions, and report generation
- Integrated testing characteristics:
 - Simulated input from S/7 SDAS simulator
 - S/370-145 to S/7 interface used to communicate data between systems
 - Controlled input simulation to provide predictable test results
 - Remote sites with formats of 15, 31, and 47 parameters simulated
 - Output for archiving and data file updating will be verified

ACCEPTANCE TESTING

- Testing environment includes all operational hardware and software
 - Site data acquisition subsystem (SDAS)
 - Telephone interface between SDAS and S/7 communication interface
 - S/7 communication interface configuration
- Controlled inputs into SDAS provides predictable data for use in verification
- Normal operational environment used for acceptance testing
 - Procedures used for control of testing
 - Test Results documented

CDPS VERIFICATION MATRICES

ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(Communications Interface)

VERIFICATION METHOD

1. SIMILARITY
2. ANALYSIS

3. INSPECTION
4. TEST

N/A NOT APPLICABLE

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
2.2 Site Directory					
2.2.1 Site Directory Information	4	4	4		
2.2.2 Site Directory Update	4	4	4		
2.2.3 Site Directory Print	4	4	4		
2.3 Communications Hardware Inter face					
2.3.1 Interface Command	1,4	4	4		
2.3.2 Data Integrity	2,4	4	4		
2.3.3 Communications Hardware Status	4	4	4		
2.4 S/7-SDAS Communications	4	4	4		
2.5 Data Store	4	4	4		
2.6 Transmit Data to Host Com- puter	1,4	4	4		
2.7 Manual SDAS Control	4	4	4		

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ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(Input Processing)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
3.2 Accept Raw Data from the S/7.	4	4	4		
3.3 Decommute Raw Data into Scans	4	4	4		
3.4 Extract Variable and Convert to Engineering Units	4	4	4		
3.5 Converted Variable Testing	4	4	4		
3.6 Compute Per- formance Evalua- tion Parameters	4	4	4		
3.7 Generate Input for Data Base Update	4	4	4		
3.8 Create History/ Archive Tape	4	4	4		
3.9 Create Input Sum- mary Reports and Error Messages	4	4	4		

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Table 6-1. Verification Matrixes (Sheet 2 of 4)

ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(File Maintenance)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
4.2 Automatic Update of Data Base	1,4	1,4	4		
4.3 Manual Input to Data Base	1	1	4		
4.4 Data Base Maintenance, Access and Update	1	1	4		
4.5 Data Base Security	1	1	4		

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ITEM (NAME AND PART NO.)
CENTRAL DATA PROCESSING
SYSTEM SOFTWARE

VERIFICATION CROSS
REFERENCE MATRIX
(User Support)

VERIFICATION METHOD 1. SIMILARITY 3. INSPECTION N/A NOT APPLICABLE
2. ANALYSIS 4. TEST

PERFORMANCE REQUIREMENT	VERIFICATION PHASE			REMARKS	
	DEVELOPMENT	QUALIFICATION	ACCEPTANCE		
5.2 Information Retrieval	1	1,4	4		
5.3 Plot Capability	4	4	4		
5.4 Generation of Scheduled Reports	1	1,4	4		
5.5 Magnetic Tape Generation	1	1,4	4		
5.6 Terminal/Batch Capabilities	1	1	4		
6.0 Performance Evaluation Data Base	1,4	4	4		
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Table 6-1. Verification Matrixes (Sheet 4 of 4)

CDPS QUALIFICATION AND ACCEPTANCE TESTING RESULTS

COMMUNICATIONS INTERFACE SOFTWARE TESTING

SITE DIRECTORY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Verification Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Maintain on S/7 Disk	2.2	2-1	X	Verified
SDAS Station Address	2.2.1.1	2-1	X	Verified
SDAS Communication Status	2.2.1.2	2-1	X	Verified
SDAS Dial Digits	2.2.1.3	2-1	X	Verified
SDAS Process Requirements	2.2.1.4	2-1,2-2,2-3,2-4	X	Verified
SDAS Data Collection Time	2.2.1.5	2-1	X	Verified
SDAS Error Information	2.2.1.6	2-1,2-2,2-3	X	Verified
Number of Disk Extents	2.2.1.7	2-2	X	Verified
Site Record Index	2.2.1.8	2-2,2-3,2-4	X	Verified
Site Byte Count	2.2.1.9	2-2,2-3,2-4	X	Verified
Initial Realtime Clock	2.2.1.10	2-2,2-3,2-4,1-2	X	Verified
BCH Errors	2.2.1.11	1-2	X	Verified
Manually Update Directory	2.2.2	2-1,2-2,2-3,2-4	X	Verified
Site Directory Print	2.2.3	2-1,2-2,2-3,2-4	X	Verified

COMMUNICATIONS HARDWARE INTERFACE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Interface Commands	2.3.1	1-1,1-2,2-3	X	Verified
Data Integrity BCH Errors	2.3.2	2-3,1-2	X	Verified
Hardware Status	2.3.3	2-3	X	Verified
Data Set Check				
Data Overrun				
System/7 XI0 Errors				
Software Error				

SYSTEM 7/ - SDAS COMMUNICATIONS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Command Message Processing	2.4.1	2-3,1-1	X	Verified
Reply Message Processing	2.4.2	2-3,1-1	X	Verified
Normal Reply	2.4.2.1			
Error Reply	2.4.2.2			
Command Definition	2.4.3	2-3,1-1	X	Verified
Command Message Format	2.4.4	2-3,1-1	X	Verified
Reply Message Format	2.4.5	2-3,1-1	X	Verified
Read Tape Reply	2.4.6	1-1,2-2	X	Verified
Communication Report	2.4.7	2-3,1-1,2-2,1-2	X	Verified

DATA STORE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Chained Buffer	2.5	1-2,2-2	X	Verified
Disk Storage	2.5	1-2,2-2	X	Verified
Update Directory	2.5	2-2,2-3,2-4,1-1	X	Verified
Time of Collection	2.5	2-3,1-2	X	Verified

TRANSMIT DATA TO HOST

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Retrieve Data from Disk	2.6	2-4,1-2	X	Verified
Build Header	2.6	2-4,1-2	X	Verified
Update Site Directory	2.6	2-4,1-2	X	Verified
Transmit Data	2.6	2-4,1-2	X	Verified
Error Recovery (*)	2.6	2-4	X	Verified

(*) - Operator error tested hardware errors would require modification of hardware being used by other programs.

MANUAL SDAS CONTROL

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development. Testing</u>	<u>Status</u>
Manually Select Site	2.7	2-2,2-3	X	Verified
Manually Select Commands	2.7	2-2,2-3	X	Verified
Print Replies from SDAS	2.7	2-2,2-3	X	Verified
Print Error Conditions	2.7	2-2,2-3	X	Verified
Selective Print of Site Data	2.7	2-2,2-3	X	Verified

INPUT PROCESSING SOFTWARE TESTING

ACCEPT RAW DATA FROM SYSTEM/7

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
S/370 - S/7 Communications	3.2	2-4,3-9,1-3	X	Verified
Input Format Definition	2.6	2-4,3-9,1-3	X	Verified
Store onto S/370 Disk	3.2	2-4,3-9,1-3	X	Verified
Error Detection/Recovery	3.2	2-4,3-9,1-3	X	Verified (Use of standard system software package)

DECOMMUTATE RAW DATA INTO SCANS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Separation of BCH's and flags from data	3.3	3-2,3-10,1-3	X	Verified
Locating Block-Starts, End-of-Blocks, and End-of-Sites	3.3	3-2,3-10,1-3	X	Verified
Extract Scans	3.3	3-2,3-10,1-3	X	Verified
Error Processing	3.3	3-2,3-10,1-3	X	Verified

EXTRACT VARIABLES AND CONVERT TO ENGINEERING UNITS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Process Variable Input Formats	3.3	3-10, 3-9 3-1, 3-8	X	Verified
Maintain Site Directory	3.3	3-1, 3-8, 1-3	X	Verified
Calibration/Conversion of Variables	3.3	3-2, 3-10, 1-3	X	Verified

CONVERTED VARIABLE TESTING

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Variables Exceeding Man/Min Limits	3.5	3-2, 3-3, 3-10, 1-3	X	Verified
Variables Exceeding Change Limits	3.5	3-2, 3-3, 3-10, 1-3	X	Verified
Time Continuity	3.5	3-3, 3-10, 1-3	X	Verified
BCII Error Testing	3.5	3-4, 3-10, 1-3	X	Verified
Rejection of Variables	3.5	3-3, 3-4, 1-3	X	Verified
No Change in Variable	3.5	3-3, 1-3	X	Verified
Error Messages	3.5	3-3, 3-4, 1-3	X	Verified
Control Over Printing	3.5	3-7, 1-3	X	Verified

COMPUTE PERFORMANCE EVALUATION PARAMETERS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Compute Performance Evaluation Parameters	3.6	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Bypass Computations Which Use Erroneous Input Data.	3.6	3-2, 3-3, 3-4, 1-3	X	Verified

GENERATE INPUT FOR DATA BASE UPDATE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Detailed Data	3.7	3-10, 1-3	X	Verified
Hourly Data	3.7	3-10, 1-3	X	Verified
Daily Data	3.7	3-10, 1-3	X	Verified

CREATE HISTORY/ARCHIVE TAPES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Raw Data Archiving	3.8	3-5, 1-3	X	Verified
Processed Data Archiving	3.8	3-6, 1-3	X	Verified
Formatting of Tapes	3.8	3-5, 3-6, 1-3	X	Verified
Printing of Tape Contents	3.8	3-5, 3-6, 1-3	X	Verified

CREATE INPUT SUMMARY REPORTS AND ERROR MESSAGES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Daily Report of Data Base Input	3.9	3-10, 1-3	X	Verified
Monthly Archiving Report	3.9	3-6, 1-3	X	Verified
Daily Input Processing Summary	3.9	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Input Processing Error Messages	3.9	3-2, 3-3, 3-4, 3-10, 1-3	X	Verified
Site Directory Contents Calibration/Conversion) Report	3.9	3-1, 3-8, 1-3	X	Verified
User Selection of Print Options	3.9	3-7	X	Verified

FILE MAINTENANCE SOFTWARE

G-31

AUTOMATIC UPDATE OF DATA BASE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Accept Output of Input Processing Software	4.2	4-1, 1-3	X	Verified
Input Format	4.2	4-1, 1-3	X	Verified
Error Processing	4.2	4-1, 1-3	X	Verified (use standard software)

MANUAL INPUT TO DATA BASE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Manual Entry of Data Via Terminal	4.3	4-1, 1-4	X	Verified
Manual Entry of Data Via Batch	4.3	4-1, 1-4	X	Verified
Editting of Input Format/ Error Processing	4.3	4-1, 1-4	X	Verified Through Use of Standard Software

DATA BASE MAINTENANCE, ACCESS, UPDATE

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Support Standard Data Base Management System Capabilities	4.4	---	X	Verified Through Use of Standard Software

DATA BASE SECURITY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Data Base Access Security	4.5	4-2	X	Verified

USER SUPPORT SOFTWARE

INFORMATION RETRIEVAL

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Support Standard Data Base Information Retrieval Capabilities	5.2	5-1, 1-5	X	Verified

PLOT CAPABILITY

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide Plots of Remotely Recorded Data to Performance Analyst	5.3	5-2, 1-5	X	Verified
Plots Generated for Tektronix 4015/4631 Terminal Unit	5.3	5-2, 1-5	X	Verified

GENERATION OF SCHEDULED REPORTS

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Use of Information Retrieval Capability to Access Data Base to Create Standard Reports (Daily and Monthly)	5.4	5-3, 1-4	X	Verified

MAGNETIC TAPE GENERATION

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide Capability to Generate Magnetic Tapes	5.5	5-4, 1-4	X	Verified

TERMINAL/BATCH CAPABILITIES

<u>Requirements</u>	<u>Performance Spec. Ref.</u>	<u>Test Cases</u>	<u>Development Testing</u>	<u>Status</u>
Provide User with Capability to Access Data Base Via Terminal or Batch Methods	5.6	5-1, 1-4	X	Verified

CPDS SOFTWARE CONFIGURATION CONTROL APPROACH

- Initial delivery establishes control baseline
- Anticipated changes to baseline
 - Site-dependent performance evaluation parameter computations
 - System improvements based on operational experience
 - Correction of problems encountered during system use
 - Changing user requirements
- Changes which impact the Performance Specification will require MSFC approval
- Software listings will be updated and released for use as changes are approved and implemented
- Tracking of software configuration via software identification and Software Release Notice

SOFTWARE IDENTIFICATION SYSTEM

DELIVERY

Site 1

Site 2

Site 3

⋮

Site n

IDENTIFICATION

Baseline

Revision 1

Revision 2

⋮

Revision X

ANTICIPATED CHANGES

Performance

Evaluation Equations

System Improvements

Problem Resolution

SIMS CDPS SOFTWARE RELEASE NOTICE (SRN)

I. SRN NUMBER: _____ SYSTEM NAME: _____
RELEASE DATE: _____ MANAGER'S SIGNATURE: _____

II. ATTACHMENTS:

1. ☐ CHANGE DESCRIPTION/LIST
2. ☐ PROBLEM RESOLUTION/LIST
3. ☐ SOFTWARE SYSTEM CONFIGURATION
4. ☐ OTHER

III. RELEASE AUTHORITY - CONTRACT NAS8-32036

IV. SYSTEM RECOVERY INFORMATION

SYSTEM/7 SOURCE STATEMENTS

SYSTEM/370-145 SOURCE STATEMENTS

NIPS LOAD MODULE

MAGNETIC TAPE	DISK DATA SET

CDPS DELIVERABLE ITEMS

- Software Listings
 - Communication Interface Software (System/7)
 - Input Processing Software (System/370-145)
- Central Data Processing System (CDPS) Users Manual
- Software Release Notice (SRN)

SIMS CDPS SOFTWARE RELEASE NOTICE (SRN)

I. SRN NUMBER: 1 SYSTEM NAME: CDPS Operational Software (Baseline)
 RELEASE DATE: 10/1/76 MANAGER'S SIGNATURE: [Signature]

II. ATTACHMENTS:

1. ☐ CHANGE DESCRIPTION/LIST
2. ☐ PROBLEM RESOLUTION/LIST
3. ☒ SOFTWARE SYSTEM CONFIGURATION
4. ☐ OTHER

III. RELEASE AUTHORIATION - CONTRACT NASS-32036

IV. SYSTEM RECOVERY INFORMATION

SYSTEM/7 SOURCE STATEMENTS

SYSTEM/370-145 SOURCE STATEMENTS

NIPS LOAD MODULE

MAGNETIC TAPE	DISK DATA SET
#1671	FHVL2341 FHS
#1617	SIMSIPS.SOURCE SIMSIPS.LOADLIB (33004)
#3385	FFSLIB (2314)

SOFTWARE SYSTEM CONFIGURATION

ATTACHMENT 3

SYSTEM NAME: CDPS Operational Software (Baseline)

S/7 Software

<u>Program Name</u>	<u>Revision Level</u>
Site Data Collect	Baseline
Manual Test	Baseline
Dump Directory	Baseline
Update Directory	Baseline

S/370-145 Software (Input Processing)

<u>Program Name</u>	<u>Revision Level</u>
Raw Data Processing	Baseline
Merge and Summary	Baseline
History	Baseline
Site Data Description Utility	Baseline
Raw Data Archiving Utility	Baseline

Data Base Software

<u>Program Name</u>	<u>Revision Level</u>
FFSLIB (NIPS)	Baseline

OPERATIONAL SUPPORT/PLANS

- Site Installation
 - Programmers will actively participate in ensuring that SDAS communicates properly with CDPS
 - Use of manual SDAS/CDPS interface capability for site installation verification
- Operational Support
 - Perform updates to CDPS software to reflect changes for performance evaluation and improved capabilities
 - Perform continuing analysis of CDPS software operation to identify improvements, to identify system problem areas, and to assist in troubleshooting suspected problem areas
 - Support users' access to the data base
 - o Training
 - o Information retrieval queries
 - o Magnetic tape generation
 - o Update of site directory information
 - o Generation/delivery of reports
- Test Results Document November 1, 1976

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